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JPRS-CEN-92-013 CONTENTS *24 December 1992*

Erratum: In JPRS-CEN-92-012, 3 December 1992, pg 24, the last line of the last paragraph should read "..... nearly 1 million tons of crude oil."

NATIONAL DEVELOPMENTS

Nation's Energy Conservation Achievements Reviewed *[State Statistics Bureau; ZHONGGUO NENGYUAN, 25 Oct 92]* 1
3.33 Billion Dollar Plan for New Power Facilities *[Chang Weimin; CHINA DAILY, 17 Dec 92]* 1
Measures To Reduce Coal Consumption Rate in Power Plants in Next 10 Years *[Yue Luqun; DIANLI JISHU, 5 Sep 92]* 2
Analysis of Line Losses in 1991 *[Wang Aijuan; DIANLI JISHU, 5 Sep 92]* 8
New Plants, Substations, Power Lines To Boost Shanghai's Economy *[Yang Ying; WEN HUI BAO, 21 Sep 92]* 12
Sichuan Power Construction Reaches New Peak *[Lu Daobin; SICHUAN RIBAO, 17 Sep 92]* 13

HYDROPOWER

Improving Environmental Impact Assessment for Water Conservancy and Hydropower Projects *[Zhao Shenshan; SHUILI FADIAN, 12 Sep 92]* 14
Implementing Resettlement Policy To Accelerate Construction of Three Gorges Project *[Qian Zhengying; SHUILI FADIAN, 12 Aug 92]* 17
Baishan Completed *[Tong Yu and Jiang Zhi; KEJI RIBAO, 21 Sep 92]* 20
Huang He Becoming China's 'River of Energy' *[Xu Xingtang, Chen Chaozhong, et al.; RENMIN RIBAO OVERSEAS EDITION, 7 Oct 92]* 20
Yantan Joins Grid; Station Is Nation's Fourth To Exceed 1000MW *[Zheng Shengfeng; RENMIN RIBAO, 17 Sep 92]* 20

THERMAL POWER

Electric Power Generation Tops Year's Goal Early *[CHINA DAILY, 30 Nov 92]* 23
Investment Prediction, Analysis of SO_2 Control in Thermal Power Plants *[Xu Fenggang, Cheng Riwang, et al.; DIANLI JISHU, 5 Aug 92]* 23
Status of Circulating Fluidized-Bed Technology Development *[Lin Zhaokui, Wang Dun'en, et al.; DONGLI GONGCHENG, 15 Oct 92]* 27
Selection of Flue Gas Desulfurization Technology *[Shu Huifen and Xu Fenggang; DIANLI JISHU, 5 Aug 92]* 28
Growth in Shanxi Power Industry Recapped *Bian Xuehai; SHANXI RIBAO, 27 Oct 92]* 31
State Approves 600MW Expansion of Daban Power Plant *[RENMIN RIBAO OVERSEAS EDITION, 26 Nov 92]* 32
Taiyuan No. 2 Power Plant Expansion *Yang Zhigang and Luo Jinqing; SHANXI RIBAO, 1 Nov 92]* 32
Work Begins on 1,400MW Yushe Plant *Shang Jinsheng, Yang Shuxiang, et al.; SHANXI RIBAO, 1 Nov 92]* 32

COAL

New Railway Construction To Give Big Boost To Coal Exports *[Xiao Jiabao; RENMIN RIBAO, 27 Oct 92]* 34
Development of Long-Distance Coal Pipelines *[Li Peifang and Liu Fangpu; MEITAN KEXUE JISHU, 25 Oct 92]* 36
10-Million-Ton Huolinhe Mine Completed *[Liu Xieyang; RENMIN RIBAO, 25 Sep 92]* 38

OIL, GAS

China's Petroleum Industry: Prospects and Concerns
[Li Yongzeng; LIAOWANG ZHOUKAN, 19 Oct 92] 40
Technology Provides Breakthrough for Oil and Gas Fields *[Li Gang; KEJI RIBAO, 16 Oct 92]* 43
Prospects of Offshore Petroleum Industry Reviewed
[Shi Ban; ZHONGGUO NENGYUAN, 25 Oct 92] 43
Update on China's 'Oil and Gas Region Tertiary Research'
[Wang Ruozhu; JINGJI RIBAO, 31 Oct 92] 46
Oil and Gas Production: Stabilization in the East, Development in the West
[Liu Sa; GUANGMING RIBAO, 1 Oct 92] 46
Accelerating Oil Exploration in Tarim Basin
[Bayangol Mongol Autonomous Prefecture People's Government Office To Support Oil Field Construction; KEJI RIBAO, 22 Sep 92] 46
Strategies of Oil and Gas Exploration in Tarim Basin Outlined
[Guo Renbing; ZHONGGUO DIZHI, 13 Sep 92] 47
Infusion of Technology at Liaohe Turns "Dead" Wells into "Live" Ones
[Miao Jiasheng; GUANGMING RIBAO, 25 Sep 92] 51
More Results From Prospecting in Xinjiang's Three Basins *[Xie Ranhao; JINGJI RIBAO, 1 Oct 92]* 52
Industrial Flow Found for First Time in Liaodong Wan *[Zhang Shirong; JINGJI RIBAO, 7 Oct 92]* 52
Chinese Petroleum Delegation Visits Four European Countries *[RENMIN RIBAO, 24 Sep 92]* 52

NUCLEAR POWER

On China's Nuclear Power Development Strategy *[Tian Li; ZHONGGUO NENGYUAN, 25 Oct 92]* 53
Work Begins on Phase Two of Qinshan Plant
[Tang Qingzhong and Zhang Jun; RENMIN RIBAO OVERSEAS EDITION, 27 Oct 92] 55
Low-Temperature Reactor Refrigeration Experiment Successful
[Jiang Hong and Ma Xuquan; BEIJING KEJI BAO, 19 Sep 92] 56

CONSERVATION

Nation's Energy Conservation Achievements Reviewed
[Qin Shiping; ZHONGGUO NENGYUAN, 25 Oct 92] 57
Strengthening Reformation of Energy Conservation Technology Under the New Situation
[State Council Economics and Trade Office Conservation Department Technical Upgrading Office; ZHONGGUO NENGYUAN, 25 Sep 92] 61
Accelerating Economic Development, Improving Energy Conservation
[Yue Luqun, Song Sen, et al.; ZHONGGUO NENGYUAN, 25 Sep 92] 65

Nation's Energy Conservation Achievements Reviewed

936B0026D Beijing ZHONGGUO NENGYUAN [ENERGY OF CHINA] in Chinese No 10, 25 Oct 92 p 8

[Data table provided by the State Statistics Bureau: "Output of Energy Resource Products, January to August 1992"]

[Text]

Table 1. Output of Energy Resource Products, January to August 1992

Item	Units	January-August		Percentage increase in total for January-August compared to same period in 1991
		Total	Monthly	
Total production of energy resources	Million tons of standard coal	688.11	91.14	2.8
Raw coal	Million tons	704.50	94.18	2.9
Unified distribution coal mines	Million tons	330.90	41.62	-0.3
Local medium-sized and small coal mines	Million tons	373.60	52.55	5.9
Coked dressed and cleaned coal	Million tons	44.58	6.16	-0.5
Coke (Machine coke)	Million tons	37.677	4.8349	6.5
Crude oil	Million tons	94.585	11.916	2.0
Amount of crude oil processed	Million tons	81.821	10.723	8.7
Gasoline	Million tons	17.502	2.134	14.5
Kerosene	Million tons	2.795	0.363	4.4
Diesel	Million tons	20.81	2.61	13.3
Lubricating oil	Million tons	1.519	0.183	10.2
Heavy oil	Million tons	21.274	2.533	3.5
Natural gas	Billion cubic meters	10.32	1.30	-
Amount of electricity generated	Billion kWh	487.89	63.96	11.2
Hydropower	Billion kWh	89.19	12.69	5.1
Thermal power	Billion kWh	395.41	48.68	11.7

3.33 Billion Dollar Plan for New Power Facilities

40100044 Beijing CHINA DAILY (Economics and Business) in English 17 Dec 92 p 2

[Article by staff reporter Chang Weimin]

[Text] China is to spend more than 20 billion yuan ($3.33 billion) building five new power stations and expanding two others to meet its growing energy needs.

So far this year, the State Planning Commission has approved 30 large power projects. When they are completed, electricity installation capacity will be increased by 17.47 million kilowatts.

The State Energy Investment Corporation said capacity of the five stations will be 4.33 million kilowatts and the other two will be increased by 1.8 million kilowatts.

The five plants are to be built in Shenzhen and Heilongjiang, Hubei, Hunan and Guangdong provinces.

The largest of the five is to be built in Shajiao in Guangdong. Its capacity will be 1.98 million kilowatts.

Approval for expansion of the other two power stations, in Gansu Province and Xinjiang, will be issued soon.

Latest statistics from the Ministry of Energy Resources show energy production this year will be equal to 1.056 billion tons of standard coal, 13 million more than last year.

Coal accounts for 74.4 percent of production, crude oil 19 percent, natural gas 1.98 percent, hydro power 4.6 percent, and nuclear power less than 0.05 percent.

The ministry estimates coal production this year will reach 1.1 billion tons, compared with 1.08 billion in 1991.

The shortage of coal supplies, a headache for years, has eased.

Stockpiles at coal mines have been reduced by 9 million tons in the first 6 months this year.

But storage at coal-using enterprises has been on the rise. At power stations, the storage would amount to 10 million tons by the end of this year.

The corporation said 1 billion kilowatt hours have been produced by China's only nuclear station at Qinshan, Zhejiang Province.

It is a small figure, but represents a breakthrough, the corporation claims.

The Daya Bay nuclear station in Guangdong Province is now in trial operation and will produce electricity and be integrated in power grids in October next year.

Up to December 14, power production this year was 705 billion kilowatt hours. Production for the entire year is expected to top 740 billion kilowatt hours, 35 billion more than the planned figure and 63 billion more than last year.

Consumption of coal has dropped by 3 grams per kilowatt hour, meaning 1.8 million tons of standard coal will have been saved this year.

The corporation also said quality of power lines has improved, cutting electricity waste in transport by 3 million kilowatt hours.

Although China's power production has steadily increased since 1988, power supply has failed to meet demand, particularly in coastal areas and in summer.

In inland provinces such as Shaanxi, Yunnan and Guizhou, supply also has been short of demand.

The estimated output of crude oil this year will be 140.5 million tons, compared with 139.76 million last year.

Onshore oil production has become difficult due to decades of exploitation. Output in inland oilfields this year did not increase.

But this was made up by an increase in offshore oil production this year, topping 3.5 million tons, 500,000 more than the yearly plan. Last year's output was 2.3 million.

Measures To Reduce Coal Consumption Rate in Power Plants in Next 10 Years

936B0010A Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese Vol 25, No 9, 5 Sep 92 pp 2-7

[Article by Yue Luqun [1471 7773 5028] of the Ministry of Energy Resources Energy Conservation Department: "Tasks and Measures for Reducing Coal Consumption in China's Thermal Power Plant During the Next 10 Years"]

[Text] **Abstract:** Average coal consumption in China's thermal power plants is about 100 g/kWh higher than in the advanced industrial nations. The main reasons are a small proportion of large generators, coal consumption in currently operating generators that is higher than design values, a small proportion of heat and power cogeneration generators, unstable coal quality, poor management, and so on. To complete the task of reducing coal consumption in our thermal power plants by 60 g/kWh over the next 10 years, we must work to build and expand large generators, upgrade generators, develop heat and power generators, and strengthen energy conservation upgrading and management. Projections indicate that the expected objectives can be attained after adopting measures in several areas during the Eighth 5-Year Plan and Ninth 5-Year Plan.

Energy resources are a major material foundation for our national economy. Since our nation was established, the CPC and government have been extremely concerned about development of the energy resource industry and China's energy resource industry has made many achievements. However, because of the high rate of growth in our national economy and continual improvements in people's living standards, demand for energy resources continues to grow. In another area, however, efficiency in our utilization of energy resources is not high and serious waste phenomena exist. Thus, the contradiction between energy resource supply and demand is becoming more prominent and has become the primary factor that restricts development of our national economy. The "10-Year Development Program for the National Economy" passed at the 4th Session of the Seventh National People's Congress stressed that the energy resource industry must "adhere to the principle of combining development with conservation and place conservation in a prominent position". It called for reducing the amount of energy resources consumed per 10,000 yuan in GNP from 9.3 tons of standard coal in 1990 to 8.5 tons of standard coal in 1995. For the electric power industry, one very important item of work is make to substantial reductions in coal consumption to supply electricity at thermal power plants. High coal consumption to supply power affects economic results in power plants and increases environmental pollution, and it exacerbates shortages in coal supplies and in communication and transportation, which restrict growth in electric power and development of our national economy. Planned power output in China by the year 2000 is 1.2 trillion kWh, of which 980 billion kWh will come from thermal power, and the amount of coal used will reach one-third of total coal output. In a situation of growing shortages of energy resource supplies, there must be a substantial reduction in the amount of coal consumed to generate electricity by the year 2000. Otherwise, power generation plans will be hard to achieve. Thus, we must search for potential, propose tasks, and formulate measures in the medium and long terms to guarantee stable forward development of the electric power industry and better service to our national economy.

I. The Current Situation in Coal Consumption To Supply Power at Thermal Power Plants

At the end of 1990, China's total installed electric power generating capacity was 137,890MW. Our thermal power installed generating capacity accounted for

101,845MW, equal to 73.9 percent. Electricity output from thermal power was 494.9 billion kWh, equal to 79.9 percent of our total power output of 621.3 billion kWh. In coal consumption to supply power by thermal power plants, because of resolute implementation by all grids, provincial electric power bureaus, and power plants of the spirit of the "two results" proposed by the Energy Resource Work Conference, coal consumption to supply electricity in China dropped from 432 g/kWh in 1989 to 424 g/kWn in 1991, ending the situation of unchanging coal consumption that failed to advance. Most thermal power plants have made substantial progress in the area of reducing coal consumption.

However, coal consumption in China's thermal power plants is still very high at present, and is even higher compared to the advanced countries. Our coal consumption to supply power is about 100 g/kWh higher than in the former Soviet Union, Japan, and other countries, as shown in Table 1. Analyzing the reasons, the main ones are in the following areas:

Table 1. Coal Consumption Levels in China Compared to the Industrialized Nations (Units: g/kWh)

Year	China	United States	England	Former Soviet Union	Japan	Germany
1980	448	378	383	328	338	340
1985	431	377	358	327	327	327
1987	432	351	358	325	325	321

A. Medium-sized and large generators account for a small proportion of China's thermal power generators

According to statistics for the end of 1990, of China's 101,840MW of thermal power, a total of 47,260MW is in generators 125MW and larger. This includes 70 125MW generators, for 8,750MW; 119 200MW generators, for 23,400MW; 32 300MW (including 250 and 330MW) generators, for 9,670MW; 12 350MW generators, for 4,200MW; and two 600MW generators, for 1,200MW. All of these are ultra-high voltage and subcritical parameter generators, and we still have no supercritical pressure generators. Generators 125MW and larger account for 46.4 percent of our total thermal power installed generating capacity, which is not a large proportion, less than one-half our total installed generating capacity. Starting in 1981, for example, 125MW and larger generators accounted for 96 percent of Japan's thermal power installed generating capacity and they have continually developed even larger capacity supercritical pressure generators. Generators of 100MW and smaller capacity were discarded long ago, and this is the case in other advanced industrial nations. In China, however, medium-sized and small condensed steam-type generators were still being built in large power grids during the mid-1980's. At the end of 1990, China had a total of 26,000MW in moderate and low-pressure condensed steam-type generators, equal to 25.5 percent of our thermal power installed generating capacity. Average coal consumption in these moderate and low-pressure condensed steam-type generators is about 600 g/kWh, and is as much as 1,000 g/kWh in some generators. This is one of the main reasons for the high coal consumption to supply power in China's thermal power plants.

B. Coal consumption to supply power in thermal power generators is somewhat higher than design values, and additional new generators are not taking advantage of lower coal consumption

During the Seventh 5-Year Plan, China added 26,650MW in large generators 100MW and larger, which is about one-half of our present generators with similar capacities. It should be said that coal consumption to supply electricity in China has dropped by a substantial amount, but in actuality this is not the case. As for the reasons, the main one is high coal consumption in large thermal power generators. Design coal consumption to supply power for Chinese-made 100MW and larger generators is 10 percent higher than similar generators in foreign countries, and they are not attaining design levels in actual operation. Because of their high coal consumption, large generators are not playing a significant role in reduce coal consumption for supplying power throughout China after being placed into operation in grids.

There are many reasons for the actual coal consumption to supply power in Chinese-made large generators being higher than the design values, the main ones being:

1. Operating parameters have not attained design values. See Table 2.

Table 2. Current Situation in Coal Consumption To Supply Power for Each Type of Large Generator, 1990 (Units: g/kWh)

Generator (MW)	Design value	Average value	Best level/better level	Worst level/poorer level
100	388-390	418	390/400	461/440
125	355-358	392	364/377	474/407
200	345-360	394	373/379	491/410
300	338-344	362	357/361	390/370
600	321	358	-	-

a. Main steam temperatures and reheated steam temperatures are lower than the design values. The generator main steam temperatures for 60 percent of the large generators now in operation are 10 to 20°C lower than the rated values and the reheated steam temperatures in most boilers are 15 to 30°C lower than the rated values. Each reduction of 10°C in main steam temperatures and reheated steam temperatures increases coal consumption to supply power from the generators by 1.1 to 0.7 g/kWh. Because the operationalization rates of high pressure heaters are low, feedwater temperatures in some plants are more than 30°C too low, which affects coal consumption by 5 g/kWh.

b. Vacuums in steam turbine steam condensers are low. In actual operation, the difference in vacuum in similar types of generators can be 3 to 5 percent or more, and very few generators attain the design vacuum of 95 percent. Each reduction of 1 percent in the vacuum in steam condensers increases coal consumption in the generators by about 1.6 to 1.8 g/kWh.

c. Boiler exhaust temperatures are too high. The boiler exhaust temperatures of many 125MW generators are 10 to 40°C too high, the boiler exhaust temperatures of 200MW generators are 10 to 30°C too high, and the boiler exhaust temperatures of 300MW generators are 20 to 30°C too high. Each increase of 10°C in exhaust temperatures increases coal consumption to supply power by about 2 g/kWh.

2. The peak operating time efficiency of large generators has declined. Because of an increase in peak-to-valley differentials and an increase in the proportion of large generators used for peak regulation in power grids, when Chinese-made large generators are at 60 to 100 percent of load, each reduction of 10 percent in load rates increases coal consumption by 5 to 8 g/kwh. Calculated on the basis of carrying valley loads for 8 hours a day, peak regulation increases coal consumption in the generators by about 6 g/kWh.

3. Unit consumption in some auxiliary equipment is high. In large generators 125MW and higher than are already in operation, there are rather substantial differentials in unit consumption in the various types of auxiliary equipment. The highest unit consumption values for feedwater pumps, ventilators, and coal pulverizers are more than double advanced values, which results in very large differentials in electricity use in plants, as shown in Table 3.

Table 3. Statistical Table By Categories of In-Plant Electricity Use Rates for 125 to 300MW Generators

Electricity use rates in plants	125MW generators	200MW generators	300MW generators
Highest	10.16	10.83	6.76
Average level	7.7-8.2	7.8-8.5	5.0-5.5
Lowest	5.87	5.08	4.31

Each increase of 1 percent in electricity use rates in the plants increases coal consumption to supply power relative to existing coal consumption to generate power by 4 to 5 g/kWh. This shows that unit consumption by auxiliary equipment has a substantial impact on coal consumption to supply electricity.

4. The reliability of generators is poor and forced shutdown rates are high, which has increased startup and shutdown losses in large generators. A recent survey shows that leaks in the "four pipes" of boilers are the most frequent cause affecting unplanned boiler shutdowns, accounting for about 70 percent. Moreover, the steam turbine vane breakages and vibration accidents that still occur occasionally and increased generator accidents have increased the number of unplanned generator shutdowns and increased startup and shutdown losses. Each shutdown of a large generator results in the consumption of an additional 150 to 300 tons of standard coal.

5. Equipment and systems are imperfect and not matched up, generator performance does not attain design values. The through-flow portions of high and low pressure cylinders, high-pressure speed regulation steam valve structures, high-pressure nozzle configurations, and so on of Chinese-made generators 125MW and larger are imperfect to the extent that their internal efficiency does not attain design levels. Much equipment is not matched up and experiments under design working conditions have confirmed that coal consumption to supply power in generators rises by 10 to 13 g/kWh.

C. A small proportion of heat and power cogeneration, existing heat and power cogeneration plants are not producing the benefits they should

Heat and power cogeneration is an extremely effective energy resource conservation measure. Industrial and civilian heat loads in China are widely distributed, and there are also quite a few relatively centralized regions, so the conditions for developing heat and power cogeneration to achieve centralized heat supplies are rather good. However, the total installed generating capacity in 6MW and larger cogeneration plants in China at present is just 9,990MW, equal to 11.3 percent of our thermal power generators of similar capacity. In contrast, the proportion of heat and power generation in several developed countries like the former Soviet Union has reached 40 percent. Starting in 1986, the United States has placed into operation 10,000MW of heat and power generators a year.

D. Unstable quality of coal supplies

During the past several years, in particular during periods of coal shortages, the quality of coal has continually

declined and the proportion of gangue has risen, which has had a major impact on coal consumption. Second, the problem of short tons and short heat value for the coal that is delivered has never been resolved. The heat value of the coal loaded into boilers is inadequate, which has resulted in coal being short when inventories are made and many power plants are unable to claim damages and can only apportion it into coal consumption. Moreover, because of the unstable quality of the coal that is delivered, quality has declined and ash and water contents have increased, which worsens wear and results in unstable boiler combustion, which reduces boiler efficiency and causes unit consumption of much of the auxiliary equipment to rise, which in turn increases in-plant electricity use.

E. Slack management, ineffective leadership

Leaders in several enterprises have a weak consciousness of energy conservation and do not work hard at energy conservation work. Added to capital shortages, many energy conservation technologies and measures are not extended and applied, so coal consumption cannot be reduced.

II. Basic Ideas for Reducing Coal Consumption

Because medium-sized and large generators account for a small proportion of China's thermal power structure at present, and because the reliability and economy of Chinese-made large generators are both relatively poor after going into operation, reducing coal consumption to supply electricity in China requires, one, installing more large generators with advanced coal consumption indices and, two, exploiting energy conservation potential in existing large generators to increase economic benefits in the electric power industry as a whole. Based on generator installation arrangements in the Eighth 5-Year Plan program for the electric power industry by the Ministry of Energy Resources and the ideas for the Ninth 5-Year Plan as well as plans for abandoning, upgrading, and replacing moderate and low-pressure generators, and taking into consideration the need to raising operating levels and reinforce technical upgrading for existing generators, I suggest the following basic ideas for a program to reduce coal consumption.

A. New generator construction and expansion should develop toward high parameters and large capacities

Coal consumption to supply electricity in newly operational large capacity condensed steam-type generators cannot exceed 330 g/kWh and cannot exceed 270 to 280 g/kWh for heat supply generators. This is especially true for regions along the southeast coast which have coal shortages, and it should be implemented even more strictly there. Permission for construction should not be given to those that exceed coal consumption standards. At the same time, measures should also be adopted for resolute prevention of more construction of medium-sized and small condensed steam-type generators in large power grids.

B. Abandon moderate and low-pressure generators

A large portion of our existing 26,000MW in moderate and low-pressure generators should be gradually abandoned and replaced by building new large generators. The generators that are replaced must truly be shut down and not transferred to tertiary industry after their service lives to ensure that coal consumption truly declines. In upgrading, we must see that upgrading in all regions with stable heat loads where heat and power cogeneration can be implemented is carried out according to the principle of "siting power generation based on heat supplies". Upgrading can take the form of increasing back pressure circulating water heat supplies, opening ports to extract steam, and so on. To make full use of the welfare facilities in locations with old plants and existing public systems, every effort should be made at local upgrading. They can be taken down first and built later, or built first and taken down later. Construction of replacement generators must make every effort to adopt 300MW and larger generators.

C. Carry out targeted upgrading for existing 100MW and larger high- pressure generators

This is particularly true for 200MW generators. Their coal consumption is universally too high, 20 percent higher than similar types of generators in foreign countries. Major upgrading should be carried out for the steam turbine through-flow portions and thermodynamic systems of this category of generators to achieve a rather substantial reduction in coal consumption.

D. Actively develop heat and power cogeneration

Along with building regional heat and power plants, actively develop enterprise reserve power plants. All industrial enterprises and units with a total heat supply capacity of more than 20 t/h and which have stable heat loads and yearly utilization times of more than 4,000 hours should consider heat and power cogeneration.

Heat and power cogeneration should adhere to the principle of "siting power generation based on heat supplies", select appropriate systems for adding heat supplies to power generation, decide on the scale and models of heat supply generators based on heat loads within the scope of heat supplies, and, with a prerequisite of guaranteeing stable generator operation and heat load rates no less than 70 percent, give preference to adopting back pressure generators or steam extraction generators and take into consideration heat load regulation performance. There absolutely can be no development of small thermal power in the name of heat and power cogeneration.

E. Reinforce energy conservation management in existing thermal power plants

Existing in-service thermal power plants should try in every possible way to reduce their own energy resource consumption, reduce in-plant electricity use rates, and raise overall system thermal efficiency. There should be

5 to 10 years of efforts to make average coal consumption to supply power from all categories of large generators in China approximate levels in state grade-1 enterprises and grade-2 enterprises.

F. Actively develop economical dispatching in power grids

Adopt measures, make unified arrangements, "replace the small with the large", try to increase the proportion of large generators in power generation, and try to shut down or reduce generation by medium-sized and small generators in grids or have them bear sharp peaks to continually reduce coal consumption.

III. Projected Reductions in Coal Consumption To Supply Power from Thermal Power Plants During the Eighth 5-Year Plan and By the Year 2000

A. Projected reductions in coal consumption to supply power from thermal power plants during the Eighth 5-Year Plan

1. Additions of thermal power generators. Most of the generators that will be placed into operation in all grids are large generators 125MW and larger. During the 5-year period, 45,000MW in new thermal power generators will be placed into operation, including 31,400MW in generators with a single unit capacity of 300MW and larger. The new generators 125MW and larger that go into operation will increase the proportion of this category of generator from the present 46.4 percent to 60 percent, which could reduce average coal consumption in China by 11.8 g/kWh over 5 years.

2. Finish replacing and upgrading moderate and low-pressure generators. Of the present 26,000MW of moderate and low-pressure generators, give consideration to the need for continued operation in frontier regions and independent power supply regions and to upgrading part of them to heat supply generators. About 16,000MW of moderate and low-pressure generators require upgrading by "replacing the small with the large". Replacement and upgrading of 5,500MW of them is planned for the Eighth 5-Year Plan. After gradually being taken out of service (and no longer generating electricity) over the years, this could reduce coal consumption to supply power in China by more than 1 g/kWh each year for a total reduction of 6.4 g/kWh over 5 years.

After old generators are taken out of service, the amount of coal they would have consumed can be supplied to about 7,500MW in replacement power plants for their use, with the other 3,000MW being used for heat and power cogeneration and 4,500MW for newly built high-efficiency condensed steam-type thermal power generators. A large part of this group of generators will go into operation at the end of the Eighth 5-Year Plan, that is in 1995, so the role of the replacement generators in reducing consumption can be fully fostered during the Ninth 5-Year Plan. If the replacement plan is completed on schedule, coal consumption to supply power in China at the end of the Eighth 5-Year Plan could still be reduced by 1.3 g/kWh as a result.

3. Reduce coal consumption in large generators now in operation. In all power grids, the proportion of installed generating capacity and power output of large generators will increase every year and the role of these generators in reducing consumption will increase each year. Each reduction of 1 g/kWh in large generators 100MW and up by 1995 can reduce coal consumption to supply power in China by about 0.7 to 0.8 g/kWh. Based on the coal consumption situation in existing generators and on the energy conservation and consumption reduction work done in large generators in the past several years, reinforcing operational management and technical upgrading (including upgrading of the through-flow portions of steam turbine generators) could reduce coal consumption to supply power each year in all categories of generators.

4. Actively develop heat and power cogeneration. At the end of 1990, heat supply generators accounted for just 11 percent of China's installed thermal power generating capacity. In the 10-Year Program, special attention should be paid to developing heat and power cogeneration, which means we must maintain the existing proportion of heat and power generators and make a net increase of 10,000MW in the installed generating capacity of heat and power generators by the year 2000. Deducting heat and power generators for "using the large to replace the small" upgrading and new additions, we must develop about 7,000MW in small-scale heat and power cogeneration over 10 years. Consideration can be given to placing 3,500MW into operation during both the Eighth 5-Year Plan and Ninth 5-Year Plan. These small-scale heat and power cogeneration generators require small investments and produce results quickly. By refitting existing small boilers, in a situation of not increasing coal indices or making very small increases in coal indices, so that we both supply heat and generate electricity, about 14 million tons of standard coal could be conserved each year after this 7,000MW goes into operation. Calculating coal consumption to supply power after apportioning heat and power at 300 g/kWh, this could reduce coal consumption to supply power by 2.4 g/kWh during the Eighth 5-Year Plan, an average reduction of 0.48 g/kWh each year.

During the Eighth 5-Year Plan, new construction, technical upgrading, and reinforced operational management will reduce coal consumption to supply power in China's thermal power plants from 427 g/kWh in 1990 to 399 g/kWh in 1995 for a total reduction of 28 g/kWh over 5 years and an average yearly reduction of 5.6 g/kWh.

B. Projected reductions in coal consumption to supply power from thermal power plants by the year 2000

During the Ninth 5-Year Plan, coal consumption in thermal power plants can be reduced further through new construction of large generators, upgrading

medium-sized and small generators, and reinforcing management of operating generators.

1. Reduce coal consumption by building new large generators. During the Ninth 5-Year Plan, China will have to place 45,000MW of thermal power generators into operation, most of which will be large generators 300MW and larger whose design coal consumption does not exceed 330 g/kWh. After they go into operation, these generators could reduce coal consumption to supply power in China by 12 g/kWh.

2. Reduce coal consumption by upgrading moderate and low-pressure generators. On the basis of upgrading 5,500MW of moderate and low-pressure generators during the Eighth 5-Year Plan, completing the upgrading of an additional 10,500MW of moderate and low-pressure generators during the Ninth 5-Year Plan could reduce coal consumption to supply electricity in China by 12.95 g/kWh. Added to the abandonment of 2,500MW of high-temperature high-pressure generators that have exceeded their service lives and requiring the construction of replacement generators to compensate for this power output shortfall, these newly-built replacement generators could also reduce coal consumption to supply power in China by 1.1 g/kWh. These two items could reduce coal consumption to supply electricity in China by 14.05 g/kWh by the end of the Ninth 5-Year Plan.

3. Reduce coal consumption in large generators now in operation. Average coal consumption to supply electricity from large generators at the end of the Ninth 5-Year Plan will still be about 20 g/kWh higher than the design value, so there is still substantial potential for reducing consumption. Further reinforcement of operational management and the adoption of technical measures, especially upgrading the through-flow portions of the remaining 200MW generators during the Eighth 5-Year Plan, would further reduce average coal consumption in this type of generator and could reduce average coal consumption in China by 5.22 g/kWh by the year 2000.

4. The role of small heat and power generators in reducing consumption. There will be 3,500MW in heat and power generators placed into operation during the Ninth 5-Year Plan. The design coal consumption to supply power for this group of generators should not exceed 280 g/kWh. This could reduce average coal consumption in China by 1.3 g/kWh.

During the Ninth 5-Year Plan, new construction, technical upgrading, and reinforcement of operational management will reduce coal consumption to supply electricity in China's thermal power plants from 399 g/kWh in 1995 to about 367 g/kWh in 2000, a total reduction of 32 g/kWh over 5 years and an average yearly reduction of 6.4 g/kWh.

Coal consumption to supply electricity in China will be reduced by a total of 60.4 g/kWh from 1990 to 2000.

IV. The Benefits of Reducing Coal Consumption To Supply Electricity By 60 g/kWh over 10 Years

A. Economic benefits

Completing the task of reducing consumption by 60 g/kWh could conserve about 55 million tons of standard coal a year by the year 2000, which is equal to 76 million tons of raw coal. At the same time, it could reduce large investments in coal mine construction and railway transportation.

B. Environmental benefits

Conserving 76 million tons of raw coal in thermal power plants could reduce dust pollution by 1.04 million tons, CO_2 discharges by 33.5 million tons, SO_2 discharges by 1.25 million tons, and NOx discharges by 970,000 tons, greatly improving the environment.

V. Policies and Measures That Should Be Adopted To Complete the Task of a 60 g/kWh Reduction in 10 Years

During the next 10 years, reducing coal consumption to supply power in China's thermal power plants by 60 g/kWh refers to potential reductions in coal consumption. To achieve this idea, there are many real problems that must be resolved and efforts must be made in the following areas.

A. We must ensure that coal consumption to supply electricity in new generators going into operation during the next 10 years does not exceed 330 g/kWh

Average coal consumption to supply power in the 300MW Chinese-made generators that China has placed into operation during the past several years is 362 g/kWh. The best is 357 g/kWh at the No 14 generator at Wangting Power Plant. Coal consumption in the new 600MW Chinese-made generators placed into operation is 361 g/kWh, which is much greater than 330 g/kWh. We must substantially reduce coal consumption in large Chinese-made generators, and we must make substantial efforts at all levels in generator design and manufacturing to continually improve designs and technologies. Machinery manufacturing departments must focus on coal consumption indices as important indicators of generator quality. Second, China's present manufacturing capacity for 300MW and 600MW generators is inadequate and far from capable of meeting demand. We must adopt a variety of measures to expand our manufacturing capacity for 300MW and larger generators, increase output, and improve quality.

B. Capital must be provided for new replacement generator projects and development of small heat and power projects

According to the plan, we must complete 7,500MW in large high-efficiency generators to replace 5,500MW of moderate and low-pressure generators during the Eighth 5-Year Plan, and we must complete 14,500MW of large

high-efficiency generators to replace 10,500MW of moderate and low-pressure generators during the Ninth 5-Year Plan. Based on the planned progress for these replacement generators, raising capital and preparatory work must be implemented from the time the projects are established. In particular, we must focus closely on this during the Eighth 5-Year Plan. Only 3 years remain between now and the end of the Eighth 5-Year Plan. The project establishment and preparatory work for the 7,500MW of generators that must be placed into operation during the Eighth 5-Year Plan should be basically implemented. During the next 10 years, we must make major efforts to develop small heat and power generators. Calculated at a total investment of 3,500 to 4,000 yuan per kW and completing 700MW each year, it would take about 2.4 to 2.8 billion yuan. At present, however, the state has special loans of about 800 million yuan, which when added to capital raised by local areas and enterprises themselves would enable about ?50MW to be placed into operation each year. If we expand the scale of construction, capital will have to be provided from many areas, and we have to raise a substantial capital for the expenditures involved in upgrading currently operating generators.

C. Implement and perfect a policy of developing small heat and power and restricting condensed steam-type small thermal power

When building large heat and power plants, we must also pay attention to developing small heat and power plants, including reserve heat and power plants. Adhere to "siting power generation based on heat supplies", do good planning for adding heat to power generation, and include this in the overall plans of cities and regions. Support and preferential policies must be implemented for small heat and power. To encourage the development of heat and power, the state has formulated several preferential policies (including heat prices, electricity prices, loans and interest, taxation, etc.), but many places have not resolutely implemented them. As for restricting small thermal power, the state has made several stipulations but a substantial amount of small thermal power is still under construction each year, especially small thermal power plants not under the jurisdiction of the Ministry of Energy Resources. Increased power output from small generators during the first quarter of 1992 increased coal consumption in power plants not under the jurisdiction of the Ministry of Energy Resources by 9 g/kWh compared to the same period in 1991.

D. Strengthen management, adopt measures, make a major effort to reduce coal consumption to supply electricity from existing generators

Thermal power plants have made substantial accomplishments in reducing coal consumption during the past 2 years but their coal consumption is still quite a bit higher than similar generators in foreign countries, so there is considerable potential for energy conservation. Thus, during the next 10 years we must truly reinforce management, exploit potential, and develop economical dispatching in a effort to reduce coal consumption. We must conscientiously adhere to and implement the "Stipulations on Energy Conservation in Thermal Power Plants" issued by the Ministry of Energy Resources, rely on three-level energy conservation networks, and resolutely undertake all types of indicator analysis and competition. We must adopt a variety of measures, especially in red-line operation of generators at the primary parameters, do good insulating, attain vacuum indices, make high-pressure heaters operate normally, prevent and eliminate leaks, and so on to raise economical operation of generators to a new level and gradually catch up with and approach advanced levels in similar generators in foreign countries.

To implement the things outlined above, many problems must be overcome, but through the efforts of all areas, the goal of reducing coal consumption to supply electricity in China's thermal power plants can be achieved.

Analysis of Line Losses in 1991

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[Article by Wang Aijuan [3076 1947 1227] of the Ministry of Energy Resources Energy Conservation Department: "Analysis of the Power Grid Line Loss Situation in China in 1991"]

[Text] **Abstract:** This article describes the line loss situation in 1991 in China's power grids and analyzes the reasons for rising line losses: 1) A rapid increase in the amount of power being supplied (sold); 2) Few investments in grid construction; 3) Changing trends in power grids and increased transmission distances; 4) Changes in the structure of electricity use; 5) Lax line management in several regions. This article also introduces several good experiences in line loss management work, and it offers some proposals for line loss work in 1992.

I. The Basic Situation for Line Loss Rates in China's Power Grids

China's electric power enterprises supplied 579.9 billion kWh of electricity and sold 532.7 billion kWh in 1991, up by 8.24 percent and 8.19 percent, respectively, over 1990. This was the year of the fastest growth in power output during the past 3 years. Line losses in China were 47.2 billion kWh, for a line loss rate of 8.14 percent, a real increase of 0.08 percent from 1990. Enterprises under the jurisdiction of the Ministry of Energy Resources supplied 502.8 billion kWh of electricity and had a line loss rate of 7.46 percent, a real increase of 0.18 percent over 1990.

The overall characteristics of line losses in China in 1991 were widespread increases, with some decreases in a few regions. Among China's 29 provinces (municipalities and autonomous regions) where statistics are available, with the exception of 12 provinces (municipalities and

autonomous regions) where line losses dropped compared to 1990—Qinghai, Shaanxi, Hubei, Fujian, Sichuan, Inner Mongolia, Guangdong, Gansu, Heilongjiang, and others—line loss rates rose in all of the 17 other provinces (municipalities and autonomous regions) compared to 1990 (see Table 1).

Table 1. Growth Rates in the Amount of Power Supplied and Changes in Line Losses in China From 1982 to 1991

Item	Year									
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Amount of power sold (billion kWh)	265.19	284.83	307.06	331.49	357.06	396.73	430.83	462.51	492.59	532.92
Rate of increase in amount of power sold (percent)	6.9	7.4	7.8	7.95	7.7	11.1	8.59	7.35	6.5	8.19
Line loss rate (percent)	8.64	8.53	8.28	8.18	8.15	8.48	8.18	8.18	8.06	8.14

In enterprises under the jurisdiction of the Ministry of Energy Resources, there were reductions in line losses in 12 provincial bureaus, including rather substantial drops in Qinghai, Shaanxi, Hubei, Inner Mongolia, and other provinces and autonomous regions. Because of the relatively small increases in the amount of electricity supplied in these bureaus, however, and because of the rather substantial increase in line loss rates in the North China, East China, and Northeast China electric power management bureaus which supply larger amounts of electricity (the amount of electricity supplied in these three bureaus in 1991 was, respectively, 93.0 billion kWh, 89.6 billion kWh, and 84.5 billion kWh, and these three bureaus together supplied 53 percent of the total amount of power supplied in China), with increases of 0.49 percent, 0.54 percent, and 0.34 percent, respectively, they played a decisive role in rising line loss rates in China as a whole in 1991.

II. Analysis of the Causes of Rising Line Loss Rates

There are five main factors causing the rise in line loss rates in China in 1991:

A. Rapid increases in the amount of power supplied (sold)

The 8.19 percent growth rate in the amount of power sold in China in 1991 was the highest year during the past 3 years (see Table 1). On the one hand, this was because industrial production had already moved out of a valley and industrial electricity use increased by 8 percent, which was nearly the level prior to improvement and rectification. The rates of increase in electricity use in the construction industry, the communication, transportation, posts and telecommunications industry, and in commerce were, respectively, 16.4 percent, 10.4 percent, and 16.2 percent. There was a large increase in electricity use in township and town enterprises, with a growth rate of 26.2 percent. Industrial electricity use grew quickest in Shandong, Zhejiang, Jiangsu, Guangdong, and other regions.

On the other hand, there were drought and waterlogging disasters over wide areas in China during 1991, which increased agricultural electricity use by 11.7 percent, an extent of growth seldom seen in recent years. This included a 20.1 percent increase in power use for drainage and irrigation, with 3.7 billion kWh more electricity being used than in 1990, when the weather was good. The increase in electricity use for drainage and irrigation was greater than 40 percent in Anhui, Hubei, Fujian, Guangdong, Shanxi, and other provinces.

Among China's 29 provinces (autonomous regions), electricity sales grew at a rate of more than 10 percent in 10 provinces (autonomous regions). The overall trend was for growth in the amount of power to be higher along the coast than in the interior. In Guangdong Province, for example, the growth rates in the amount of electricity sold in Zhongshang and Dongguan were 66.2 percent and 56.6 percent, and the growth rates in electricity sales in Fuzhou and Shaoxing were 16.9 percent and 18.4 percent.

The rapid increase in power output placed huge pressures on power grids that were originally rather weak and on power transmission and transformation equipment that was being operated at excessive loads, and it increased grid losses. For example, the main transformers at the 200 kV Leizhuang transformer site, main transformers at the 110 kV Yutian transformer site, the 110 kV Lei-Ben line, and others in the Tangshan Power Supply Bureau have been operating at full load or overload for a long period, especially the 10 kV cables in the city grid that operated at more than 30 percent overload for a period of time, which increased power losses in this bureau by an additional 44.70 million kWh in 1991. Thus, a rapid increase in power output is a major factor behind rising line losses in China.

B. Small investments in power grid construction

Because of the implementation of raising capital to develop power during the past several years, China has installed over 10,000MW of generators each year, far greater than levels during the Sixth 5-Year Plan and before. However, raising capital to develop power often focuses only on construction of power plants and the capital for the associated grid construction is not implemented, so grid construction cannot match up with power source construction. In 1991, for example, 25.4 billion yuan was invested in power generation projects in China whereas only 5.2 billion yuan was invested in power transmission and transformation projects, equal to 20 percent of the investment in power generation

projects. There was a addition of 12,880MW in power generation capacity larger than 500 kW, an increase of 24 percent over 1990, while 7,600 kilometers of 110 kV and above power transmission lines were added, a reduction of 1,995 kilometers compared to 1990. There was an addition of 13.96 million kVA in power transformation capacity 110 kV and above, a reduction of 3.40 million kVA compared to 1990. Looking at the situation during the past decade, the ratio of power grid investments to power source investments dropped from about 30 percent during the Sixth 5-Year Plan to about 20 percent during the Seventh 5-Year Plan (see Table 2).

Table 2. Ratio of Investments in Power Generation Projects and Power Transmission and Transformation Projects During the Sixth 5-Year Plan and Seventh 5-Year Plan

Item	Year						
	Average for 1981-1985	1986	1987	1988	1989	1990	1991
I. Power generation projects (billion yuan)	21.20	9.26	10.32	16.62	17.58	22.20	25.4
II. Power transmission and transformation projects (billion yuan)	6.28	2.67	3.83	3.85	3.77	4.13	5.22
II:I	0.30:1	0.29:1	0.37:1	0.23:1	0.21:1	0.18:1	0.20:1

Of the capital used for technical upgrading, the proportion used for grids is also rather small and energy conservation projects that are urgently needed and that would have good results are hard to implement on time. In this type of environment, safe and stable operation of the system is affected and line losses are increased.

For example, our reactive compensation capacity is inadequate. In 1991 China's capacitive degree of reactive compensation was 0.42. If the degree of compensation was calculated at a more reasonable 0.6, China would have a reactive capacity shortage of more than 20 million kvar, but investments in capacitors as a proportion of capital for technical upgrading have tended to decline in recent years. Capital construction projects must conserve investments, and the first thing cut is reactivity (including inductive compensation). The result has been low system voltages during peak periods and high voltages during valley periods. At the 220 kV transformer site at Dukou in Sichuan, for example, the maximum voltage has risen above 260 kV and it frequently operates at 250 kV. There are many similar examples throughout China. Of course, the voltage problem in an electric power system is a complex problem and insufficient reactive compensation is just one of the causes, but this point can be confirmed: a large amount of reactivity circulating in a grid can increase power losses.

In another example, many of the transformers now operating in grids are high-loss transformers from prior to JB-64 standards. It will take money to replace these old high iron loss transformers but progress in work to replace high-loss transformers has been very slow because of insufficient capital for technical upgrading.

C. Changes in grid trends, increased transmission distances

In 1991, transmission distances in many grids increased as a result of more output from hydropower, replacement of small generators with large ones, substituting coal for oil, and other reasons. For example:

1. Northeast China Grid: Because 1991 was another wet year, output from hydropower increased by 31.7 percent over 1990 and a large amount of hydropower was transmitted over long distances, causing a substantial increase in primary grid losses.

2. Northwest China Grid: Power output from Ankang Hydropower Station almost doubled between 1990 and 1991 and it was transmitted via a 330 kV line to the Guanzhong [central Shaanxi plain] Grid, which increased power losses by 20 million kWh.

3. East China Grid: Power output from Wangting Power Plant at the load center increased by only 5.66 percent while the amount of power supplied to the grid by Huaneng's Nantong Power Plant increased by 53 percent over 1990 and it passed through the Haian-Jiangdu line to the main grid. Statistics for July, August, and September in 1991 showed an increase of more than 80 percent in the amount of power transmitted on the Haian line compared to 1990. This increased the absolute value of line losses on this circuit by 1.17 percent.

4. North China Grid: Because of a reduction in oil burning indices from 1990 that reduced power output from oil-fired generators in the load center of the Beijing-Tianjin-Tangshan Grid, more power was transmitted at 220 kV and higher to the main grid. This item alone increased grid losses by 27.6 million kWh and caused an increase of 0.07 percent in line loss rates in the Beijing-Tianjin-Tangshan Grid.

D. Changes in the structure of electricity use

For the past several years, household electricity use by people in urban areas has grown very quickly but the pace of urban grid construction and upgrading has been far slower than increases in loads. In Shanghai Municipality, for example, average annual sales of electricity increased at a rate of 21.9 percent from 1987 to 1991, and the low-voltage grid overloading and choking situations were serious. Total social electricity use in the

Northwest China Grid in 1991 increased by 6.55 percent. Agricultural and urban and rural resident household electricity use, where line loss rates are higher, increased by 14.76 percent and 16.3 percent, respectively, whereas electricity use in industry, where line loss rates are lower, increased by only 4.77 percent.

E. Lax line loss management in several regions

Line loss work in several regions has been lax in the past 2 years and there are many leaks. For example, the errors in some key gauges are very large and the CT change ratios and PT secondary voltage drops exceed stipulations. Management of electricity use in some stations is disorganized and some of the electricity that is sold cannot be immediately recovered. In some cases there is a failure to recover it and in others they purposely do not recover the power and do not collect electricity fees. There are serious phenomena of electricity stealing in several places. This has led to inaccuracies and substantial increases in line losses, and it has a direct impact on economic results in electric power departments.

Most bureaus, however, are quite concerned about line loss work. For example, the Northeast China and Northwest China Electric Power Management Bureaus and the Jiangsu, Hubei, Hebei, and other provincial electric power bureaus have accumulated rich experience in focusing on line loss management work and have obtained rather good results.

III. Some Good Line Loss Management Experiences

Grid load rates in the Northeast China Electric Power Management Bureau were low in 1991 and regional electricity use continued to increase. In a situation of quite a few past due accounts in network upgrading over the years, stable line loss rates with some reductions were maintained in the regional grid. The primary methods were: 1) Reinforced management by objectives, a focus on loss trend analysis, immediately searching for the causes of abnormal line loss rate conditions, and the adoption of measures. 2) Trial implementation of standardized line loss management in power supply bureaus, improvement of contractual responsibility methods, and a start on trial implementation of "Power Supply Bureau Line Loss Management Standards" in 1991 in bureaus under its jurisdiction. For high-loss circuits, some bureaus implemented contractual responsibility for risk or mortgage bonus contractual responsibility. 3) Reinforced operational management.

The characteristics in the Northwest China Electric Power Management Bureau were: 1) Resolute work on line loss rate voltage dividing and determination of the amounts of power lost on lines based on statistics on the structure of power output; 2) Reinforced management of transformers used to fight drought, implementation of the principle of "supplying when used, shut down when not supplying" for transformers used to fight drought based on agricultural needs. According to incomplete statistics, this item alone led to a total of 3,700 shutdowns of transformers used to fight drought in the Shaanxi region during 1991, conserving 5.92 million kWh of electricity.

IV. Some Proposals for Line Loss Work in 1992

Compared to several years in the past, 1992 will be a year of relatively rapid growth in China's economy and the rate of growth in power output will be higher than for several years in the past. However, our present grid structure and pace of grid construction and upgrading are quite incapable of meeting the increased demand for electricity. Thus, we face a very serious situation in line loss work in 1992 and for this reason I suggest we focus on the following items of work in 1992:

A. Reinforce line loss organization and daily management work

Based on the requirements in the "Management Provisions Regarding Grid Power Losses in Electric Power Grids" (abbreviated below as the "Provisions") promulgated by the Ministry of Energy Resources: 1) There should be departments with clear responsibility for line loss management in all bureaus; 2) Integrate with contractual responsibility, implement management by levels and small indicator checks for line loss rate indicators, do immediate analysis of fluctuations in line loss rates to determine causes and adopt countermeasures; 3) Do statistical work divided by voltages and divided by lines (divided by regions) for line losses, compare them with the corresponding computed values, gain an understanding of the structure of power lost through line losses; 4) Undertake line loss computation work. Current line loss statistics were calculated using the margin method. This type of computation method concealed many management losses, so doing line loss computations would aid in discovering problems in management, in grid structures, and in equipment (gauges) for targeted adoption of improvement measures. According to the requirements in the "Provisions", one computation must be made each year for systems 35 kV and up and one computation must be made every 2 years for systems 10 kV and below.

B. Reinforce grid construction and upgrading, increase reactive compensation

We must achieve a matchup between grid construction and power plant construction, change the past situation in which several locations were only concerned with power plant construction and paid no attention to grid construction, increase the proportion of investments in power grids, and improve the configuration of grids. Gradually build new lines and transformer sites based on the principle of optimized operation to shorten the radius of power supplies and reduce circuitous power supplies. Special attention should be given to matching construction of power grids. Various channels should be used to raise capital to build and upgrade matching grids and improve the current situation in grid overload operation.

All bureaus should do a survey of the number and capacity of high-loss transformers within the scope of their jurisdiction and formulate plans for how many years it would take to complete the job, how much should be invested, and how great the benefits should be. The benefits from replacing high-loss transformers can consider at least three areas: 1) Power conservation benefits after transformer losses (mainly iron losses) are reduced; 2) Reserve capacity provided to their systems after reducing iron losses; 3) Increases in power supply capabilities for systems after reducing iron losses.

China currently has a shortage of more than 20 million kvar in reactive capacity and most locations have inadequate reactive capacities. Some locations have sufficient total reactivity but its distribution is irrational, so grids can use reactivity optimization computations in their grids as a basis for accelerating the placing of reactive equipment into operation. For those which have a relatively high degree of reactive compensation but which is irrationally distributed, they can reconfigure it based on the results of reactive optimization.

C. Use coal and electricity conservation awards properly

In some locations, coal and electricity conservation awards are now basically allocated to everyone. Energy conservation awards have become a part of wages and play no good role in encouraging conservation. For this reason, all areas should formulate (or revise) rational allocation methods that help to encourage energy conservation. Based on the requirements in the detailed implementation principles of the "Provisional Regulations for Energy Resource Conservation Management" in the electric power industry and different situations in each of the bureaus, issue coal and electricity conservation awards to units and individuals related to energy conservation according to the size of their contributions. Energy conservation management departments should propose that 30 to 40 percent of total bonuses be used to reward units and individuals that have significant achievements in energy conservation and make large contributions to energy conservation.

In summary, line losses in China increased during 1991 and there are both subjective and objective reasons for this. In 1992 we again face a situation of rapid growth in our national economy and substantial increases in electricity use, so the prospects for further reductions in line losses are not optimistic. However, if leaders and electric power employees at all levels work together and exploit potential in management and technology, it will still be possible to maintain stable line losses with some reductions during 1992.

New Plants, Substations, Power Lines To Boost Shanghai's Economy

936B0009B Shanghai WEN HUI BAO in Chinese 21 Sep 92 p 1

[Article by reporter Yang Ying [2799 5391]]

[Text] The development of Pudong has reached a new stage; electric power construction is in a horse race, and the furious construction activity at the Waigaoqiao power plant sets the scene as the curtain is raised on large-scale electric power construction in the Pudong New Zone. Two 750,000 kVA transformers at the 500-kV Yanggao substation are on line; three 220-kV extra-high voltage power lines from the Pudong Yanggao substation to the Yangshupu power plant, the Pudong and the Zhoujiadu substations are all completed. These "hardware items" make up a brand new grid, and adding to that the Pudong Power Supply Department has already implemented special procedures and emergency priority "software items" to support the economic manifold economic development of Pudong.

Because Pudong has economically lagged behind Puxi for so long, electric power has here-to-fore mainly been directed to Puxi. In the new zone there is not one single puplic power plant, there being only two 220-kV, two 110-kV substations, and 18 35-kv substations. In 1990, the Pudong New Zone's peak load was only 380,000 kW, and volume of consumption was 2.32 billion kWh, less than 10 percent of the whole municipality.

The development of Pudong is stimulating a large-scale development in Pudong electric power construction, and reporters at the Waigaoqiao power plant witnessed pile-driving that was about finished, a 240-meter smokestack that already stands 20 meters high, and preliminary preparations for construction that are basically done. This power plant is one of the 10 major capital construction projects in Pudong, and is programmed for a total installed capacity of 3.6 million kW, of which, in the first-phase of construction four 300,000 kW units will be installed. The second- and third-phase plan will augment the facility with two 60,000 kW units in each. These domestic large-sized port thermal power projects will not only be able to satisfy the Pudong New Zone's economic development needs, but will also serve as the Gezhouba-to-Shanghai, Xuzhou-to-Shanghai, and Huainan-to-Shanghai 500,000 volt power line interchange and collection points at the Nanqiao and Huangdu substations. It will also link up the local Baoshan Shidongkou No 1 and No 2 power plants, will form a major grid for the Shanghai area, and will supply reliable power for the overall economic development of Shanghai. In step with all of this, the Pudong New Zone will spin a web over Pudong with a large number of 220-kV and 35-kV substations, starting with the 500,000-volt Yanggao substation capital construction project.

To keep pace with the construction of the large power network for the modernization of Pudong, the Pudong Power Supply Department is rejuvenating the old power grid. The Municipal Government has assigned No 1 key project status to the Gaoyang route which will have the most extensive construction of accessories for power supply, an expenditure about 50 million yuan; and besides taking down the original transmission lines, 380 new power poles will be erected, 26 kilometers of power line will be set up, 25.5 kilometers of underground cable will be put down, and 47 transformers and over 1,000 lights will be installed. The Shanghai Municipal Power

Supply Bureau assembled all of its engineering might, organized a competitive achievement environment, and with over 1,000 workers going day and night for more than a month, efficiently and excellently completed their Yanggao main power accessories construction targets ahead of schedule, completing one-half year's work in one month in order to assure that conditions would be right for completing the Yanggao route expansion by year's end. The leading Japanese-owned enterprise, the Ailisi [Onishi?] Textile Corporation, went into formal operation after only 400 days from start of project discussions, as workers of the Shidong Power Supply Bureau worked through the winter completing 4 months of work more than 3 months ahead of schedule, and began to supply electric power to consumers in only 20 days, earning great praise for the Shidong Power Supply Bureau from the Japanese Corporation for its high efficiency.

Electric Power Department specialists say that according to preliminary estimates, by the end of the century the Pudong New Zone's peak load will reach 1.2 million kW, about 3 times that of 1990, and requirements will be up to over 5 to 6 billion kWh. For this reason, besides the power resources now under construction and in addition to supplying power for engineering, the Pudong New Zone will build five 220-kV substations at Zhangqiao etc., before the year 2000 for a total capacity of 1.2 million kVA, but additional construction and expansion will further necessitate construction of more than 30 35-kV substations for a total capacity in excess of 1 million kVA. In time, Pudong will attract even more commercial participants into the excellent investment environment and its new electric power network structure.

Sichuan Power Construction Reaches New Peak

936B0009A Chengdu SICHUAN RIBAO in Chinese 17 Sep 92 p 1

[Article by reporter Lu Daobin [0712 6670 2430]]

[Text] The Sichuan Electric Power Industry, taking advantage of the opportunity of the reforms, has hastened the pace of electric power construction. During the Seventh 5-Year Plan 1.7 million kW of new electric power facilities went into operation, 6.3 times that of the Sixth 5-Year Plan. In the Eighth 5-Year Plan, the average annual increase in installed power station capacity was over 600,000 kW, and new equipment that will be coming on line during the 5-year period will overtake the 3 million kW mark, double that of the Seventh 5-Year Plan. Power stations now under construction are on a scale that tops 6 million kW, a surge of growth unseen in the total 40 years of reconstruction in the Sichuan power industry.

In the spring of 1989, the provincial government invited 60 noted hydropower specialists from across the country to make an on-the-spot investigation of the Jinsha Jiang, Yalong Jiang, and the Dadu He watershed to substantiate and perfect an energy resources and power development plan for Sichuan. Subsequently, construction of the Ertan power station with a total installed capacity of 3.3 million kW was formally undertaken, signalling a new era for Sichuan's hydropower development. The Provincial Committee Secretary, Yang Audai, and Governor Zhang Haoruo often visited the worksites at Baozhusi, Tongjiezi, Jiangyou, and Luohuang to give support and encouragement to the project.

Following the financial system reforms, Sichuan explored many avenues, levels, and forms to raise funds for electricity. After Chongqing Municipality and the International Huaneng Electric Power Development Corporation embarked in a joint venture for the construction of Luohuang power station, the expansion of the Baima and Jiangyou power plants, the Baozhusi, Ertan, and the Taipingyi hydropower projects, the 200,000 kW Chengdu power plant expansion, and the two 200,000 kW projects at Huangtongzhuang power plant were undertaken in succession, and many units have already gone into operation.

The electric power departments took it on as their mission to increase the efficiency of electric power supply. The Provincial Power Bureau optimized the cooperative movement, assembled forces against disasters, guaranteed funds, goods and materials where needed, made preparations for construction, shakedowns, and production, and met their schedules. The Chongqing and Baima power plant expansions were done quickly and with good quality. Planning and construction of power source points and power grids were stepped up concurrently. Before the Ertan power station went into operation, the electric power departments built a number of medium-sized hydropower stations to ease the shortage of electricity. Of the Nanya He cascade power stations, the Yele and Yacheba stations are now in early preparation stages.

Improving Environmental Impact Assessment for Water Conservancy and Hydropower Projects

936B0018 Beijing SHUILI FADIAN [WATER POWER] in Chinese No 9, 12 Sep 92 pp 3-6

[Article by Zhao Shenshan [6392 3234 1472] of the Central Water Conservancy and Hydropower Planning and Design Academy: "Focus on the Main Issues To Do Water Conservancy and Hydropower Project Environmental Impact Assessment Work Well"]

[Text]

I. Introduction

According to provisions in the Environmental Protection Law of the People's Republic of China and the "Construction Project Environmental Protection Management Law" promulgated by three state ministries, environmental impact assessment work must be carried out during the feasibility research stage for water conservancy and hydropower projects. To do this work well, water conservancy and hydropower design departments must conscientiously study the possible short-term and long-term impacts that construction of a project might have on the environment and prepare to adopt countermeasures and measures.

During the past several years, water conservancy and hydropower departments have been doing environmental impact assessment work for water conservancy and hydropower projects under construction and planned for construction, and they have obtained some experience and achievements, but many problems still exist and remain to be solved.

Water conservancy and hydropower projects are unlike other industrial projects. The scope of their impact is larger, they have more factors with impacts, and their relationships are very complex. This substantially increases the amount of work that must be done in making the assessments. Thus, focusing on the primary issues that have greater impacts on the environment is the key to doing environmental impact work for water conservancy and hydropower projects well.

II. The Question of the Primary Environmental Impacts That May Appear in Water Conservancy and Hydropower Projects

There are many categories of water conservancy and hydropower projects and the primary issues involved in the environmental impacts of different categories of water conservancy and hydropower projects are also different.

A. Projects with reservoirs

Generally speaking, the primary environmental problems caused by reservoir projects lie in the following areas:

1. The question of reservoir resettlement and arrangements. Examples include soil erosion caused by destroying forests and reclaiming wasteland; various social problems that result from instability in the lives of residents caused by dealing improperly with the arrangements and changed living environments; contamination of water quality caused by developing township and town enterprises around reservoirs during the development-type resettlement process, and so on.

2. Induced earthquakes that might be generated after a reservoir impounds water that damage structures and may even endanger the lives and property of residents near the project.

3. Reservoir landslides due to long-term immersion and scouring by wind and rain after a reservoir impounds water that destroy farmland, roads, and structures, increase silt accumulation in reservoirs, and so on.

4. Land salinization that may occur because of rising groundwater levels around a reservoir after it impounds water, and so on.

5. Possible changes in water quality caused by the impoundment of water in a reservoir. Examples include an increase in nutrients in a reservoir caused by a failure to clean the bottom of the reservoir and by leaves and weeds around it falling into the reservoir and decomposing; the flow of large amounts of polluted water into the reservoir because of poor control when developing township and town enterprises around a reservoir; if there are pollution sources upstream from the reservoir and on the banks of tributaries, the concentration of pollutants can increase because of the slower flow after a reservoir impounds water.

6. Changes in the temperature structure of water after a reservoir impounds water that may cause layering phenomena with the temperature of the upper layer approaching the air temperature during the summer while the lower layer may be lower than the air temperature. In this case, if water diversion devices are installed at the bottom of the reservoir to drain water for irrigation, freezing of crops may occur over a substantial area downstream.

7. Direct effects on the living environment of land organisms from reservoir inundation. There is a substantial impact on aquatic organisms after a dam is built, especially on migratory fish species.

8. In rivers with a large amount of silt, silt accumulates in the reservoir region and at the backwater end, which can reduce an impoundment reservoir's capacity and may cause the riverbed to be raised, affecting communication and transportation. Sand bars can also form at the mouths of tributaries where they flow into the reservoir and affect their drainage. This may cause scouring of the river channel downstream, affect the stability of its banks, change the hydraulic conditions in the river channel, and so on.

9. After a reservoir impounds water, there is a substantial increase in its water area that may have an impact on the atmospheric conditions of the reservoir region and the surrounding area such as increasing wind speeds, humidity, precipitation, air temperatures, and other changes in climatic factors.

10. Cultural relics in the reservoir region may be inundated or immersed.

11. There can also be several effects on human health in the reservoir region and surrounding area, some of them unfavorable, such as a possible expansion in the range of water-borne diseases resulting from the increased water area, introduction of various contagious diseases into the resettlement area by the movement of the resettled population, and so on. It can also have several favorable effects, such as expansion of the water area and increased water depths that can submerge water accumulation pits and lowlands where mosquitoes breed in the reservoir region that can reduce the carriers of diseases, high-fluorine regions, or local diseases caused by poor water quality. If the water quality is improved, these local diseases can be reduced, and so on.

12. Lowering of water levels or reductions in flow rates in the river channel downstream from a reservoir that impounds water may affect household water supplies and industrial and agricultural water supplies on both banks.

B. Water diversion and water transfer projects across river basins

Changes in water quality, soil salinization, and the impact on the ecology and environment downstream arising from reductions in the amount of water, and so on can be important environmental problems in multi-river basin water transfer and water diversion projects.

C. Flood diversion (detention) projects

The environmental impact in flood diversion (detention) basins only cause serious destruction during flood diversion periods, but the actual history is very short and some can be restored only after the floodwaters have passed. Thus, the focus should be placed on effects that are not easily restored. For example, there is no way to recover important cultural relics if they are destroyed, so this should be studied as an important issue.

III. Comprehensive Analysis To Determine Important Issues in Projects

The main problems listed above that might occur refer to regular water conservancy and hydropower projects, but for a specific project, all of them may not necessarily be important problems. Thus, there must be comprehensive analysis on the basis of survey research and the characteristics, functions, scale, importance, and natural conditions of a project as well as its geographic location to determine the primary environmental problems of the project. I will provide a further description below by using several project examples.

A. Daguang Dam Hydropower Project on Hainan Island

Based on its scale, this project will have a reservoir with a capacity of 1.5 billion m^3 that covers a relatively large area and will require the resettlement of nearly 20,000 people. Because the region is rather backward and still practices slash-and-burn cultivation, soil erosion may result from the resettled population's clearing of forests and reclamation of wasteland. The Datian Slope Deer [po lu 0980 7773] Natural Protection Area is nearby. The slope deer is a valuable animal. If the resettlement arrangement region is placed near the protection area, this area may be affected, so the environmental impact of resettlement is the primary problem.

The primary function of the reservoir is for power generation but it will also have irrigation and water supply tasks, so there will be specific demands on water quality. The reservoir is in a tropical rain forest region in a river basin that contains many trees and rather good vegetation. After the reservoir impounds water, decayed plants from the surrounding area and the reservoir region flowing into the reservoir may cause problems by increasing nutrients and the water quality would become the primary problem.

A large part of the reservoir region has minority nationalities. They are relatively backward in their economy, culture, and other areas, the public health conditions are poor, and because this is a tropical zone, it is conducive to the transmission of diseases. Thus, sufficient attention should be paid to the human health question in the construction area, around the reservoir, and in the resettlement area.

B. Taolinkou Reservoir on the Qinlong He in Hebei Province

This reservoir will have a total capacity of 2 billion m^3, so it is about the same in scale as Daguang Dam Reservoir. Its primary function is to provide water to Qinhuangdao and the east Hebei iron and steel base area downstream and to Tangshan City, and it will also have irrigation tasks. Thus, rather high demands will be placed on water quality and the water quality of the reservoir has become the primary question for this project. The population to be resettled totals more than 40,000, double that for Daguang Dam, but the population resettled from this region will generally be moved and dispersed downstream, so forest destruction, wasteland reclamation, and similar problems are not too prominent. Thus, the environmental impact of population resettlement is not the primary problem when compared to Daguang Dam. However, there are quite a few residents along both banks of the river channel downstream and during non-irrigation periods if the reservoir does not release water into the river channel downstream it may cause the water level in the river channel to drop and water levels in the permeable wells along both banks would also drop and even dry up,

affecting the drinking water for people and livestock along both banks, so research should be done on this as the key problem.

C. Xiaolangdi Project on the Huang He

Because of the substantial silt content in the Huang He, silt accumulation and scouring of the river channel downstream are the main environmental problems. This region historically has been culturally developed and has quite a few cultural relics, which is an issue of concern to cultural relic and environmental protection departments, so research should be done focused on protection of cultural relics.

D. Gezhouba Project on the Chang Jiang

Because the Chang Jiang is the river in China with the most developed water- borne shipping, the impact of this project on shipping is a prominent problem. The Chang Jiang is rich in aquaculture resources and has the Chinese sturgeon, a precious fish species that also has the habit of migrating upstream to spawn. The dam will have a rather large impact on fish breeding after it is built, so its impact on aquatic organisms is the primary environmental problem. The project is located very close to Yichang City and will have a large number of construction workers and a large construction work site, so it will have a significant environmental impact on the surrounding area during the construction period, which is another focus of research.

E. The project to divert water from the Huang He to the Dian He

Diversion of water from the Huang He into the Dian He is a cross-basin water reallocation project. If the water diversion intake is placed near Baipo on the Huang He, the quality of the water that is diverted would be better, as would the conditions for extracting the water, but diverting more than 100 m^3/second of water during the dry season would reduce the flow rate downstream. If this is done and the polluted water that was originally flowing into the lower reaches is not treated, the concentration of the original pollution in the water would increase because of the reduction in the amount of water, which could affect the quality of the water diverted to Zhengzhou City. As a result, Henan Province is extremely concerned about this and conscientious research is needed. Moreover, there are quite a few pollution sources along the water transport canal and effective measures are essential to guarantee that the water diverted to Baiyangdian is relatively clean. For this project, the water quality issue is extremely important. The water in the Huang He has a rather large silt content, so precipitation measures must be adopted, but this requires a depositing pool covering a large area. If the design chooses to place the depositing pool near the large Shahe Swan Natural Protection Area in the Xinxiang region, it would take up a small area of the natural protection region and the water transport canal would pass through the natural protection region near its center, which would have a substantial impact on the swan natural protection area, so research must be done on the extent of the impact and measures to reduce it must be adopted. These two problems have the greatest relation to the project to divert water from the Huang He into the Dian He, so assessment units must do intensive and detailed work before they can persuade environmental protection departments.

F. The project to divert water from south to north China

Because the line this project will take is long and the region it passes through has many industrial plants, pollution is relatively serious. The target of the water it will supply is water used for industry and agriculture and some water for household uses, so the water quality requirements are relatively high and water quality should be the key problem to study. Could the diseases of southern China, especially schistosomiasis and its parasite oncomelania, spread along with the diverted water into north China; because the project runs from south to north China, it would disrupt existing water conservancy systems, so could it cause salinization of the soil along its course; because the water is taken from a place very near the mouth of the Chang Jiang and a relatively large amount of water will be diverted during dry seasons, could a drop in the water level in the Chang Jiang cause an inversion in the flow of saltwater. These questions are the environmental questions that must be answered in this project and should be the focus of assessments.

All of the projects listed above have their own important environmental questions and should be the focus in pre-assessments to propose corresponding countermeasures and reduce the environmental impact of these projects.

III. Propose Countermeasures and Measures, Prevent and Reduce Unfavorable Impacts of Projects on the Environment

The goal in building water conservancy and hydropower projects is to transform the environment and create prosperity for mankind. Thus, consideration must be given to reducing the negative environmental impact of projects to the minimum degree. This requires the adoption of specific countermeasures and measures. For projects that serve as water source areas to supply water, water source protection management regulations must be formulated and the water pollution situation must be closely monitored to strictly control discharges of polluted water into the water source area. For example, Miyun Reservoir is Beijing's main water source area. Besides strictly controlling pollution sources upstream from the reservoir, tourism in the reservoir must be prohibited to ensure that the water in the reservoir is not contaminated. The more than 7,000 people resettled for Hainan Island's Daguang Dam Hydropower Station must have arrangements near the Datian Slope Deer Protection Area in Dongfang County. To guarantee the safety of slope deer, part of the metal fence around the slope deer protection area must be replaced with a brick

wall. In the project to divert water from southern to northern China, to ensure that flow reversal of seawater does not occur at the mouth of the Chang Jiang during the dry season, when the flow rate is less than 7,000 m^3/s no more water should be pumped from the river and prevention and allowance methods should be adopted.

If construction of a reservoir has a serious impact on the environment that cannot be compensated for by appropriate measures, the plan program must be readjusted or another suitable location must be chosen. An example is Longmen Reservoir in the middle reaches of the Huang He. It is a cascade that was decided upon during planning for the Huang He during the 1950's. Because no environmental assessment work was done in the past, it has consistently been considered a primary cascade on the northern trunk of the Huang He. Environmental assessment work has been done in the past several years, however, and it was discovered that the high dam program at Longmen would submerge Hukou Waterfall, a scenic region famous in China and foreign countries, and as a result it attracted the attention of people in all areas in China and abroad. If this dam were to be built, this scenic spot would be submerged. Comparing such a big loss to the power generation, flood control, and irrigation benefits that would be obtained by building Longmen Reservoir, it cannot be stated that the benefits far exceed the disadvantages because the losses that would occur would be irreversible. Thus, although design units had already expended a large amount of manpower and materials conducting the survey and design, much more careful work had to be done for comparison in every effort to protect Hukou Waterfall.

IV. Some Points of View and Opinions

1. Water conservancy and hydropower projects have both favorable and unfavorable environmental impacts. Work to assess favorable environmental impacts merely requires analysis and discussion during comprehensive assessment, and the focus should be placed on doing intensive analysis and discussion regarding detrimental impacts. Moreover, there are two aspects to detrimental impacts. One is the harmful environmental impacts of projects. The other is harmful impacts of the surrounding environment on the projects. Both must be elaborated clearly in assessment work. Water diversion projects, for example, can cause salinization of the soil along their course. This is an unfavorable environmental impact, but polluted water along their course that is discharged into the water transport canals can contaminate the quality that formerly was of relatively good quality and affect water supplies. This is an impact of the environment on a project. There must be rational analysis and clear responsibilities during the assessment process. Proposals for countermeasures and measures and estimated investments done in this way will not push the responsibility entirely onto the project.

2. Attention must be paid to reviewing completed projects. Because environmental impact assessment work for water conservancy and hydropower projects got started relatively late and the methods are not very mature yet, there is too little data for comparative analysis before and after a project is built, so there are more difficulties involved in pre-assessment. There are many common problems in actual water conservancy and hydropower projects, especially in regions with similar natural and geographic conditions. Using analogous analysis methods is a rather direct and effective method. Sanmen Gorge Reservoir, for example, has been in operation for over 30 years and all of the project's environmental problems have already been revealed. A review assessment of Sanmen Gorge can be used as an analogy for the Xiaolangdi project downstream and the conclusions drawn will be believable and rational.

3. Experience in environmental assessment work should be summarized. Environmental impact assessments have been done for many of our projects now and we have accumulated rich experience, but we lack summarizations, so this type of situation often occurs: some problems are already understood at one place but are still being studied at another place and there is much repetition of work. Thus, comprehensive summarizations should be done according to region, scale, natural conditions, and so on for all the projects that have been completed in China to search for several regularities.

4. Environmental work should be one of the goals of a plan in the river basin planning phase. There are two levels of meaning in doing environmental impact assessment at the same time as river basin planning work. One is setting environmental improvement objectives based on a large amount of surveys and analysis. For example, during the river basin planning phase for the Hai He, because the present water quality situation in many areas of the river basin was rather poor, improving water quality should be an important objective in the plan. When formulating plan programs, improvement in water quality should be a primary objective. The second is, after an initial selection of planning programs has been made, environmental impact assessments should feed back the detrimental impacts to the program and appropriate measures adopted or the program revised so that the unfavorable environmental impacts of the project are at a minimum. This can attain the "unification of three into one" for economic, social, and environmental benefits.

Implementing Resettlement Policy To Accelerate Construction of Three Gorges Project

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[Article by Qian Zhengying]

[Text] The Conference To study the Outline for the Three Gorges Resettlement Program opened on 3 June for a 6-day session. The Conference heard a report on the "Outline" from the Ministry of Water Resources' Chang Jiang Water Resources Committee, studied pertinent documents of the central authorities and the State

Council, heard representatives from affected locations and departments, and with a high sense of responsibility toward the country and the people, through group discussion, conference speeches and individual exchange of opinion they debated the "Outline", they studied every line and word from the thoughts of the leadership to concrete documents, each expressing his views freely and openly, and brought forth many worthwhile opinions and suggestions. Based on the wide-ranging debates, on the morning of the 7th, two leading groups convened an expanded conference, and collectively proceeded with deliberations. After this meeting all ideas were linked up and a common understanding was reached. The conference sent forward a draft of the "Outline" in which all concurred, and proposed a number of important revisions, principal among which was the call to fully reflect the spirit of state approved investigative report by Tian Jiyun into the "Outline". A summary of initial findings of the leading group opinions are presented here. Following the conference the Ministry of Water Resources was requested to take charge, and in accordance with conference opinions with respect to the "Outline", to make revisions in the "Outline", and also to send the revised draft to Sichuan and Hubei for their opinions, then deliver it to the Sichuan Three Gorges Project Pilot Project Working Leading Group for a decision, and request approval and dissemination by the State Council. The conference members were asked to point out omissions and inaccuracies in the document after the conference in order to facilitate printing and distribution and authentication for action: the document subsequently to be issued by the State Council will be accepted as final. The following issues are for discussion.

(1) Guiding Thoughts on Resettlement Arrangements

The question of whether the Three Gorges project will proceed smoothly turns on whether resettlement can proceed smoothly. The State Council organizations involved, and the Sichuan and Hubei Party and Governments must expend great efforts and work in full cooperation to carry out resettlement. Economic construction is in progress everywhere in the country, and as the people in reservoir areas also also hope to escape poverty and become affluent, and they should be given full consideration, respect and support. For this reason close attention must be given to planning and arranging at the outset for the resettlement effort, and not just let the people be moved out. The Three Gorges project must be the turning point, and become an economically lifting, environmentally beautifying, and an example for the security and happiness of the people, and it should establish a strategy for further development along the river, and thereby become springboard for economic development of the country's heartland. To realize this goal the principle of national support for resettlement from reservoir areas must be assured; secondly, the principle of preferential policy of must be unwavering; thirdly, there must be support to all locales; and fourth, there must be support for the principle of self reliance.

(2) Long-Range Reservoir Development and Present Resettlement Goals

The long-range goals of reservoir development are: economic growth, a beautiful natural environment, and a secure and happy livelihood.

The present resettlement goals are: The productivity and living conditions of the people being relocated must be even better than they are at present; they should be comfortably well off.

(3) The Link Between Socio-Economic Development and Suitable Resettlement

Three Gorges resettlement arrangements are the crux of socio-economic development in reservoir zones. The Three Gorges resettlement program is a building block of socio-economic development in the reservoir zone, but it cannot override the planned socio-economic development of reservoir zones.

Under the guidance of the State Council, the various levels of government must formulate a socio-economic development plan that makes a proper resettlement program critical to the urban and rural socio-economic development in the reservoir zone. The overall development program is a very important part of the whole, and the way to succeed with the development program is to follow the four principles of the guiding thoughts as expressed above, and to open many channels for funding it.

(4) The Way To Arrange Rural Resettlement

Two policies must be upheld; one is to adhere to the idea that resettlement should be a rewarding policy; two is to support a policy that agricultural is central to the integration of agriculture, industry, and commerce. Reservoir zones of every location must make use of their own resource advantages, be realistic, multi-channeled, multi-industrial, and relocations should be well arranged in many forms and manners. Special attention must be given to a rational development of local resources. This is crucial to whether the rural resettlement can be successful. There can be no destruction of forest and creation of wastelands. For this reason the "Forestry Laws" must be emphasized in the formulation of the resettlement program. There should be a rational plan for the development of uncultivated land under conditions that strictly protect water and soil, and improve the ecological environment. The criteria for relocation and resettlement areas is to have, per capita, one-half mu of land of high and stable yield, and one mu of park land; and in order to retain surplus land, the arable lands and water surface areas in the inundated spaces of the reservoir zones can in no way be counted among resources for resettlement. As to how much, if any, resettlement is to be arranged by improving low-productive lands, that is to be determined locally according to actual situations. If a given county's land

resources are insufficient, higher authorities will determine the arrangements to be made in neighboring counties, and the central authorities will make arrangements for resettlement out of province.

(5) Program for Relocation Construction in Cities and Towns, and Reconstruction of Specialized Facilities

These are matters to be taken up under the guidance of the social administrative departments of the State Council. The goals of criteria for relocation construction and reconstruction of specialized facilities, besides the reasonable criteria slated for handling the inundated areas, may also, through relevant stipulations by competent authorities, be slated for relatively high development standard. Implementation of multilateral funding, may be done in a single step, or start out low and end up high, or developed in incremental periods.

The State Bureau for Preservation of Cultural Relics is responsible for planning for protection of cultural relics. After the Bureau sets down stipulations, it is requested that an itemized report be given to the Chang Jiang Water Resources Committee. The Ministry of Forestry in cooperation with the Chang Jiang Committee is requested to draw up a plan for protecting the forests in the vicinity of reservoir zones.

(6) Investigative Report on the Material Indicators of Inundation

A review of the indicators of reservoir inundation is an initial step in designing the resettlement program. It is a very complex and detailed exercise requiring much effort. This is headed by the Chang Jiang Committee with the active participation of the various levels of local governments of the two provinces. The external investigations are nearly completed. Generally speaking, this investigation was done quite smoothly with all diserved respects and appreciation to the arduous efforts of personnel of the various levels of local government and members of the Chang Jiang Committee.

A detailed report on the external investigation data from the Chang Jiang Committee and local governments is needed to proceed with a rational analysis, and questions arising from the investigation and qualitative questions that remain concerning some of the findings will be discussed by the Chang Jiang Committee and local governments in order to reach a reasonable solution. If the two parties have unresolved questions the Pilot Leading Group may be asked to make final resolutions. As to Chongqing Municipality and Kaixian issue concerning the terminus of the reservoir, specialists will be sent by the Proof Leading Group in September or October of this year to Chongqing to investigate and reach a solution.

(7) Clarifying Policies in the "Outline"

It is the opinion of the conference members that policies and measures should be clearly defined in the outline of the resettlement program. The relevant policies addressed in the feasibility report, and even with respect to furthering reforms, the feasible policy suggestions that came out of the study should be specified and brought into play in a working resettlement policy.

(8) On Implementing the Project Resettlement

To accomplish the Three Gorges project resettlement as quickly as possible, it was imperative that the outline issued by the State Council Three Gorges Project Resettlement Pilot Group put out an outline for implementing an incremental program be subject to deliberation in conference. The circulation of the staged resettlement program is innovative and beneficial to the strengthening of the resettlement program. It is hoped that priority will be given uniformly to arranging the resettlement from dam areas, the development of the land resources of the agricultural people, and the relocation construction in small towns, and even in the counties that can readily absorb the resettlement from the peripheral areas, that it will all be accomplished in the early stages of implementation the program. Completing dam area resettlements first, would be salutary, and here, Ichang Municipality can surely break new ground, and gain valuable experience in implementing the program.

(9) Strengthening the Leadership of the Two Provinces and Various Levels of Government in the Resettlement Program

The State Council decrees that the resettlement effort must effectively fall to the local governments, especially the county and rural governments. In order to fully accomplish the resettlement, a general plan must first be formulated. Only through pooling the leadership of the two provincial governments and relying on the municipal, prefectural, county and rural governments and the Chang Jiang Committee is a proper outcome possible. Looking back to 1986, through the great efforts and support of the two provinces, the discussions and feasibility report for the Three Gorges was accomplished. After the National People's Congress passed the Three Gorges project, the two provinces and municipalities, prefectures, and counties promptly took action, and unleashed various forces to get the Three Gorges effort going. It is believed that after this conference, under the leadership of the two provinces, and support for the Chang Jiang Committee a resettlement plan will promptly be formulated, and the conditions for full development of the Three Gorges project will be at hand. For this, the Ministry of Water Resources is requested after the conference to prepare the finances for the preparatory work, and get the concurrence of the two provinces on the revised outline.

It must be emphasized that the various organizations of the two provinces had already done a large amount of the work years ago. The Three Gorges cadres made a great contribution to formulating and getting approval for the feasibility report for the Three Gorges project, and this conference extends to them deserved respect and appreciation. The Three Gorges project will span the turn of

the century, and the resettlement effort must have continuity. There are those who have been involved with resettlement for many years. They are knowledgeable, and many will be reaching retirement age, but they are in good health and can be of service. The leadership should consider continuing to make the most use of their talents, and not dismiss them solely based on the issue of age.

Baishan Completed

936B0008B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 21 Sep 92 p 1

[Article by Tong Yu [1749 1342] and Jiang Zhi [1203 3112]: "Northeast China's Largest Hydropower Station Completed"]

[Text] Baishan Hydropower Station, a key state project and northeast China's largest hydropower station, was completed and placed into operation on 20 September 1992. This hydropower station is located in Huadian City, Jilin Province. It has a total installed generating capacity of 2,500MW and is primarily responsible for peak regulation, frequency regulation, and accident reserve uses in the Northeast China Grid. It carries out dispatching jointly with the famous Fengman Hydropower Station and can increase annual power output at Fengman Hydropower Station by 46 million kWh.

Huang He Becoming China's 'River of Energy'

936B0008C Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 7 Oct 92 p 2

[Article by reporters Xu Xingtang [1776 5281 1016], Chen Chaozhong [7115 2600 0022], and Zhu Wenzhi [2612 2429 1807]: "The Huang He Is Becoming China's 'River of Energy'"]

[Text] A Chinese coal expert stated that it would not be boasting to say that the middle reaches of the Huang He at the Shanxi-Shaanxi-Inner Mongolia border is a large sea of coal, with proven reserves of several 100 billion tons. China has a total of four huge coal fields and this area accounts for three of them: Shaanxi's Shenfu Coal Field, Shanxi's Qinshui Coal Field, and Inner Mongolia's Dongsheng Coal Field. Shenfu and Dongsheng Coal Fields have also been named one of the world's seven largest superior quality coal fields. Moreover, the large Jungar open-cut coal mine and others are located here.

Information from the relevant persons indicates that the coal at the Shanxi- Shaanxi-Inner Mongolia boundary has several common characteristics: low sulfur, low ash, and high heat content, and all of it is superior quality power coal.

China is now developing the coal fields here on a large scale. The relevant experts estimate that by the end of this century this zone will become China's new coal capital. Besides the Shanxi-Shaanxi-Inner Mongolia boundary, there is also the Yuxi [West Henan] Coal Field and Jinnan [South Shanxi] Coal field in the middle reaches of the Huang He, while in the upper reaches there are Inner Mongolia's Uda Mining Region, Ningxia's Dawukou and Shizuishan, and so on. The proven coal reserves in the Huang He river basin account for more than 46 percent of China's total coal reserves.

Besides coal, the Huang He river basin also contains extremely abundant petroleum, natural gas, hydropower, and other resources.

Now, four large oil fields at Changqing, Yanchang, Zhongyuan, and Shengli have been discovered and developed in succession in the river basin from the middle to the lower reaches of the Huang He. Among them, Shengli Oil Field is located in the Huang He delta and is China's second largest oil field after Daqing Oil Field, with yearly crude oil output of more than 33 million tons, equal to almost one-fourth of China's total petroleum output. Zhongyuan Oil Field ranks fifth among China's oil fields and has paragenetic oil and gas, with abundant natural gas resources. Apparently, prospecting departments also recently discovered China's biggest natural gas field in northern Shaanxi with proven geological reserves of as much as 80 billion cubic meters and extremely broad development prospects.

According to information provided by deputy chief engineer Deng Shengming [6772 4141 2494] in the Huang He Water Conservancy Commission, the abundance of hydropower resources on the Huang He is second only to the Chang Jiang in China. According to a hydropower resource survey and development program for the Huang He, 38 hydropower stations could be built on the trunk of the Huang He with a total installed generating capacity of up to 28,220MW and yearly power output of as much as 105 billion kWh, about 6.2 percent of power output from hydropower planned in China.

To date, seven hydropower stations have been completed on the trunk of the Huang He at Longyang Gorge, Yanguo Gorge, Bapan Gorge, Liujia Gorge, Qingtong Gorge, Tianqiao, and Sanmen Gorge with a total installed generating capacity of 3,620MW and yearly power output of 17.6 billion kWh.

An economics expert said in overview that the Huang He has now become "China's River of Energy" and that the energy from the Huang He will play an enormous role in China's future economic development.

Yantan Joins Grid; Station Is Nation's Fourth To Exceed 1000MW

936B0008D Beijing RENMIN RIBAO in Chinese 17 Sep 92 p 1

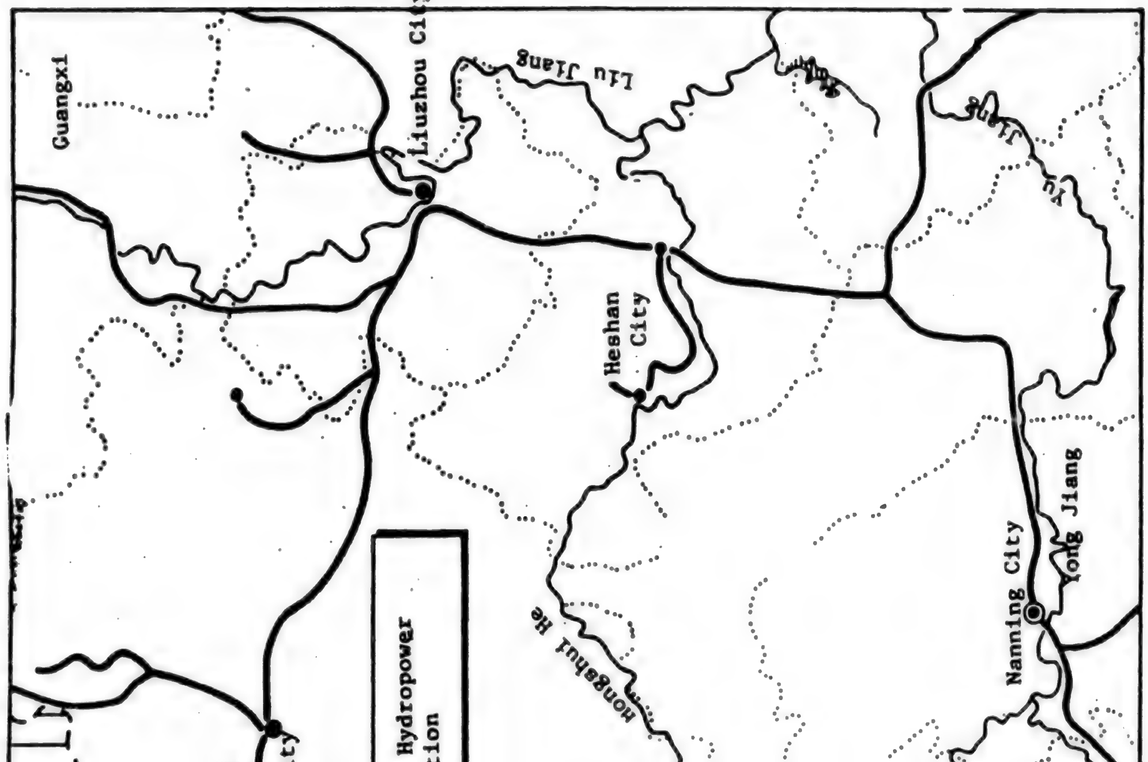
[Article by reporter Zheng Shengfeng [6774 4141 0023]: "Yantan Hydropower Station Connected to Grid and Generates Power, China's Fourth Large Hydropower Station Over 1,000MW, Generates Power One Year

Ahead of Plans, Can Increase Value of Output By 16.8 Billion Yuan, Taxes and Profits By 2.8 Billion Yuan"]

[Text] After 72 hours of successful trial operation, Guangxi's Yantan Hydropower Station, a key state construction project, formally connected its first generator to the grid and generated power 1 year ahead of predetermined plans on the morning of 16 September 1992. This is China's fourth large hydropower station over 1,000MW after Gezhouba, Longyang Gorge, and Baishan to be placed into operation and generate power.

With an appraised and ratified budgetary estimate of 1.632 billion yuan in 1984 and a total installed generating capacity of 1,210MW, Yantan Hydropower Station located on the middle section of the Hongshui He is one of the key power stations among the 10 cascade power stations on the Hongshui He. Placing the power station into operation ahead of schedule will help alleviate Guangxi's electricity shortage and it will aid in accelerating construction of a passageway to the sea for southwest China, in accelerating development of the Pingguo large aluminum industry base area near the power station, and in accelerating the long-distance supply of electricity from the Hongshui He to parts of the south China and southwest China regions. Moreover, it will have significant direct social and economic benefits from generating power 1 year ahead of schedule. It will generate an additional 5.6 billion kWh of power, which is equivalent to conserving about 2.4 million tons of standard coal, it will increase the industrial value of output by 16.8 billion yuan and income from taxes and profits by 2.8 billion yuan, and make a corresponding reduction of 50 million yuan in 1 year's interest on the construction investment.

Yantan Hydropower Station is the first large hydropower station to implement a proprietor overall contractual responsibility system and comprehensively implement a project bid solicitation and bid submission reform trial point. In November 1985, the Ministry of Water Resources and Electric Power, which was the unit that awarded contractual responsibility at the time, and the Guangxi Electric Power Bureau, which was the unit with contractual responsibility for the investment, signed the first "project construction contractual responsibility contract" in China between the two parties for construction of a large hydropower station. The unit awarding contractual responsibility implemented "three guarantees" for the capital, the three types of materials, and the equipment required or the project, while the unit with contractual responsibility for construction implemented "five types of contractual responsibility" for the project's investment, construction schedule, quality, materials, and safety. Implementation of the new system ensured smooth progress in construction of Yantan Hydropower Station.


Guangxi
Liuzhou City
Liu Jiang
Yu Jiang
Heshan City
Yantan Hydropower Station
Hongshui He
Hechi City
Nanning City
Yong Jiang
Tian'e
Hongshui He
Baise City
You Jiang
Zuo Jiang
Guizhou
Vietnam

Electric Power Generation Tops Year's Goal Early

40100038 Beijing CHINA DAILY in English 30 Nov 92 p 1

[Excerpt] China already has fulfilled the year's target for construction of electric generating plants—54 days ahead of schedule.

By November 17, the country upped its generating capacity by 8.65 million kilowatts from the installation of 49 sets of large and medium-sized electric generating units, surpassing the official construction target of 8.627 million kilowatts for the whole year.

The total added generating capacity is expected to hit 11.5 million kilowatts by the end of the year, the China Construction Newspaper reported last week.

The newspaper report also said that this year's newly-installed power projects went into operation in a balanced way and the volume of each generating unit was larger than previous ones.

In the past, most power projects went into operation during the fourth quarter of the year, usually in December.

Yet, due to the continuous coordination efforts of the country's Ministry of Energy Resources, this years's projects were put on line throughout the year, with some going into operation in nearly every month of the year. Increases in generating power averaged more than 2 million kilowatts in each quarter.

According to the vice minister of the Ministry of Energy Resources, Shi Dazhen, the country's total electric generation output is expected to reach 870 billion kilowatt-hours by the year 1995, when the Eighth 5-Year Plan ends.

In meeting that quota, he said, China is to build a group of electric power plants in areas near coal mines, ports and railways. [passage omitted]

Investment Prediction, Analysis of SO_2 Control in Thermal Power Plants

936B0004B Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese Vol 25, No 8, 5 Aug 92 pp 5-8

[Article by Xu Fenggang [1776 7685 0474] and Cheng Riwang [4453 2480 2489] of the Ministry of Energy Resources Safety and Environmental Protection Department and Xu Dingfeng [6079 1353 1496] of the China Electric Power Enterprise Federation: "Forecasts and Analysis of China's Investments in Thermal Power Plant SO_2 Control"]

[Text] **Abstract**

This article introduces several types of desulfurization technologies used in coal-fired power plants and their investment and operating costs to propose four types of desulfurization programs and point out that collecting an added fee in electricity prices to accumulate capital to develop new desulfurization technologies is a capital channel to solve the desulfurization problem at coal-fired power plants.

I. China's SO_2 Discharges and the Urgency of Controlling Them

Since reform and opening up, China's electric power industry has developed quickly. We used 261.68 million tons of coal to generate electricity in 1991, equal to 25 percent of China's total coal output in the same year. At the same time, there has been a rapid increase in the SO_2 discharges created by burning coal. China's total industrial discharges of SO_2 in 1991 were 15.59 million tons. Of this amount, the electric power industry discharged 4.60 million tons of SO_2, equal to 29.5 percent of China's total industrial discharges of SO_2. By the year 2000, coal consumption in China will surpass 1.4 billion tons. If there is no additional control, industrial discharges of SO_2 from burning coal will reach 20.57 million tons and SO_2 discharges from thermal power plants will reach 9.50 million tons, equal to 46.2 percent of China's total industrial discharges of SO_2.

Acid rain has become an acute environmental problem in the world today. China's acid rain is of a sulfuric acid type that is created mainly by discharges of SO_2 from the burning of coal. Now, Guangdong, Guangxi, the Sichuan Basin, and most of Guizhou have become the world's third largest acid rain region after Europe and North America, and acid rain causes substantial direct and indirect economic losses each year.

Thermal power plants are big dischargers of SO_2. At present, however, reducing SO_2 pollution depends mainly on rational deployments, controlling the scale of construction, building tall smokestacks, using the atmosphere's dispersion and self-cleaning capabilities, and other methods. While using tall smokestacks for discharges does reduce the concentration at the ground surface somewhat, it also expands the scope of SO_2 transmission and increases the possibility that acid rain will form. For this reason, developing and utilizing desulfurization technology to reduce discharges of SO_2 into the atmosphere and achieve basic control of SO_2 pollution is essential. Desulfurization at thermal power plants involves enormous investments and high operating costs. Given China's situation of a limited economic bearing capability, we must make appropriate selections of desulfurization technology based on China's national conditions while at the same time opening up capital channels for thermal power plant desulfurization.

II. Desulfurization Technologies Appropriate for Coal-Fired Power Plants and Their Investment and Operating Costs

There are now over 100 types of desulfurization technology but the types of desulfurization technology for coal-fired power plants listed below are the mature ones:

1. Wet limestone-gypsum method This is the most widely used and most technically mature desulfurization technology at the present time. The wet method technology accounts for 86 percent of all of the world's flue gas desulfurization facilities.

2. Rotary spray dry method desulfurization technology Compared to the wet method limestone-gypsum method, the rotary spray dry method flue gas desulfurization technology involves lower investments, accounting for about 15 percent of the total investment in a power plant.

3. In-furnace sprayed calcium desulfurization technology Although development and utilization of this technology remained stagnant for a time, it has seen renewed application and development in foreign countries during the past several years.

During the Seventh 5-Year Plan, Luohuang Power Plant imported two complete sets of wet-type limestone-gypsum desulfurization facilities with two matching 360MW generators from Japan's Mitsubishi Corporation and the No 1 development facility has now been placed into operation and has attained its design desulfurization efficiency. The No 2 desulfurization facility has begun carrying out partial operation. In addition, Baima Power Plant developed its own rotary spray drying desulfurization intermediate testing facility that can treat 70,000 Nm^3/h of flue gas and it now has the conditions to expand to applications in 100MW and 200MW generators.

Because of the different flow processes, equipment, absorbents, desulfurization efficiency, and so on for each of these desulfurization techniques, their initial investments and operating costs are also different, with substantial differences in some cases (see Table 1).

Table 1. Coal-Fired Power Plant Desulfurization Techniques and Their Technical Economics Parameters

Desulfurization technique	Scope of applications	Desulfurization efficiency (percent)	Initial investment*		Operating costs (yuan/ t x SO_2)
			Yuan/kW	Yuan/t x SO_2 x year	
Rotary spray drying	Moderate and high-sulfur coal, mainly used in newly-built generators and old generators that have the conditions for upgrading	80-90	300	3,100	300
In-furnace sprayed calcium in conjunction with wetting activation	Moderate and low-sulfur coal, suitable for upgrading old generators	60-70	225	2,800	240
Wet-type limestone-gypsum method	High-sulfur coal, suitable for use in newly-built generators	90-95	430	3,950	420
Circulating fluidized bed	Moderate and high-sulfur coal, suitable for use in newly-built generators	80-90	344	3,350	190

* Calculated at a sulfur content of 2 percent for the coal being burned

III. Projected Investments in SO_2 Control Programs

Program 1: By the year 2000, control SO_2 discharges from thermal power plants at the 1990 discharge level of 4.17 million tons.

Desulfurization technique: In-furnace sprayed calcium wetting and activation; rotary spray drying.

Pace of implementation: Begin operation in 1996.

Projected results: Form the capacity to reduce SO_2 by 5.33 million tons a year by the year 2000 and attain 124,600MW in generating capacity outfitted with desulfurization equipment at a total investment of about 33.4 billion yuan (see Table 2).

Table 2. Program 1

Item	Year					
	1996	1997	1998	1999	2000	Total
Average sulfur content of coal being burned	1.18 percent					
Control technology	In-furnace spray calcium with wetting and activation, rotary spray drying					
Amount of SO_2 generated (million tons)	7.43	7.95	8.46	8.98	9.50	42.32
Amount of reduction in SO_2 (million tons)	1.09	2.18	3.27	4.36	4.17	15.07
Amount of SO_2 discharged (million tons)	6.34	5.77	5.19	4.62	5.33	27.25
Generator capacity outfitted with desulfurization (MW)	24,900	49,800	74,800	99,700	124,600	373,800
Capital construction investment (billion yuan)	5.8	5.8	5.8	5.8	5.8	29.0
Operating costs (billion yuan)	0.29	0.58	0.87	1.16	1.45	4.35
Total investment (billion yuan)	6.09	6.38	6.67	6.96	7.25	33.35

Program 2: Based on the national SO_2 discharge control goals formulated by the State Environmental Protection Bureau, total discharges of 16 million tons in China in 1995, with thermal power plants accounting for 35.7 percent of the amount discharged; total discharges of 18 million tons in China in 2000, with thermal power plants accounting for 39 percent of the amount discharged.

Desulfurization technique: In-furnace sprayed calcium wetting and activation; rotary spray drying.

Pace of implementation: Begin operation in 1994.

Projected results: Form a yearly SO_2 reduction capability of 1.32 million tons in 1995 and 2.60 million tons in 2000, attain 56,100MW in generating capacity outfitted with desulfurization equipment at a total investment of about 17.9 billion yuan (see Table 3).

Table 3. Program 2

Item	Year							
	1994	1995	1996	1997	1998	1999	2000	Total
Average sulfur content of coal being burned	1.18 percent							
Control technology	In-furnace spray calcium with wetting and activation, rotary spray drying							
Amount of SO_2 generated (million tons)	6.28	6.91	7.43	7.95	8.46	8.98	9.50	55.51
Amount of reduction in SO_2 (million tons)	0.66	1.32	1.58	1.84	2.09	2.34	2.60	12.43
Amount of SO_2 discharged (million tons)	5.62	5.59	5.35	6.11	6.37	6.64	6.90	43.08
Generator capacity outfitted with desulfurization (MW)	14,230	28,470	34,000	39,520	45,050	50,570	56,100	267,940
Capital construction investment (billion yuan)	0.37	0.37	1.45	1.45	1.45	1.45	1.45	14.65
Operating costs (billion yuan)	0.18	0.35	0.54	0.54	0.55	0.62	0.68	3.46
Total investment (billion yuan)	3.88	4.05	1.99	1.99	2.00	2.07	2.13	18.11

Program 3: Collecting a fee of 0.20 yuan/kg for SO_2 discharged by thermal power plants and using all of it for SO_2 control.

Pace of implementation: Begin operation in 1996.

Desulfurization technique: In-furnace sprayed calcium wetting and activation; rotary spray drying.

Projected results: Form a yearly SO_2 reduction capability of 2.12 million tons by 2000 and attain 51,000MW in generating capacity outfitted with desulfurization equipment at a total investment of about 13.5 billion yuan that can control SO_2 to 1996 discharge levels (see Table 4).

Table 4. Program 3

Item	Year					
	1996	1997	1998	1999	2000	Total
Average sulfur content of coal being burned	1.18 percent					
Control technology	In-furnace spray calcium with wetting and activation, rotary spray drying					
Amount of SO_2 generated (million tons)	7.43	7.95	8.46	8.98	9.50	42.32
Amount of reduction in SO_2 (million tons)	0.42	0.84	1.26	1.48	2.10	6.10
Amount of SO_2 discharged (million tons)	7.01	7.11	8.20	7.30	7.40	37.02
Generator capacity outfitted with desulfurization (MW)	10,290	20,400	30,600	40,800	51,000	153,090
Capital construction investment (billion yuan)	2.37	2.37	2.37	2.37	2.37	11.85
Operating costs (billion yuan)	0.12	0.24	0.36	0.48	0.60	1.80
Total investment (billion yuan)	2.49	2.61	2.73	2.85	2.97	13.65

Program 4: Outfit all generators that go into operation after 1995 with desulfurization facilities in Sichuan, Guizhou, Guangxi, and Guangdong, which have serious acid raid, and in the east China and north China regions, which discharge large amounts of SO_2.

Pace of implementation: Begin operation in 1995.

Desulfurization technique: In-furnace sprayed calcium wetting and activation; rotary spray drying.

Projected results: Form a yearly SO_2 reduction capability of 1.18 million tons by 2000 and attain 24,000MW in generating capacity outfitted with desulfurization equipment at a total investment of about 7.6 billion yuan (see Table 5).

Table 5. Program 4

Item	Year						
	1995	1996	1997	1998	1999	2000	Total
Average sulfur content of coal being burned	1.18 percent						
Control technology	In-furnace spray calcium with wetting and activation, rotary spray drying						
Amount of SO_2 generated (million tons)	6.91	7.43	7.95	8.46	8.98	9.50	49.23
Amount of reduction in SO_2 (million tons)	0.20	0.39	0.59	0.79	0.98	1.18	4.13
Amount of SO_2 discharged (million tons)	6.71	7.04	7.36	7.67	8.00	8.32	45.10
Generator capacity outfitted with desulfurization (MW)	4,000	7,900	12,000	16,000	20,000	24,000	83,900
Capital construction investment (billion yuan)	1.23	1.01	1.01	1.00	1.00	1.00	6.25
Operating costs (billion yuan)	0.07	0.13	0.18	0.24	0.30	0.36	1.28
Total investment (billion yuan)	1.30	1.14	1.19	1.24	1.30	1.36	7.53

IV. Capital Channels for Desulfurization in Coal-Fired Power Plants

Analysis of the four desulfurization programs listed above shows that controlling the amount of SO_2 discharged by thermal power plants to a significant degree will require huge investments and operating expenses each year. To raise this amount of capital and attain the goal of spurring control of SO_2 without affecting development of the electric power industry, there must be extensive research and comprehensive comparison of capital channels.

China's thermal power installed generating capacity has grown quickly during the past several years and there has been a rapid expansion of fixed assets, debt, and the administrative scale of electric power enterprises. The amount of power they generate and the taxes they pay have also grown rather quickly, their social benefits are relatively good, and they have played an active role in development of our national economy. However, as the installed generating capacity has grown, irrational electricity prices and tax rates have caused profits in the electric power system to decline every year and some enterprises already have serious losses, with some bordering on the verge of losses. This is particularly true of provinces and autonomous regions with relatively weak economic foundations like Sichuan, Guizhou, Guangxi, and others where electric power enterprises have an even stronger sense of crisis, but these regions are also key regions for controlling SO_2. If electric power enterprises in these regions have to digest capital for desulfurization themselves, electric power enterprises will immediately suffer losses, which will affect the self-development of electric power enterprises and have an impact on economic development in these backward regions.

Research done in China and foreign countries shows that increasing electric power as a proportion of total energy consumption helps conserve energy resources and reduce discharges of pollutants generated by burning coal. Excessive direct utilization of coal causes an increase in energy consumption per unit of product in industry and exacerbates the impact of environmental pollution. Thus, the state must accelerate development of the electric power industry, use more coal to generate electricity, and provide society with more clean energy: electricity. However, dealing with the environmental side-effects of SO_2 pollution caused by establishing thermal power plants also requires the expenditure of considerable effort. This sort of duality that arises from burning coal to generate electricity means that controlling SO_2 pollution is a public matter that creates prosperity for society and its necessary costs must be obtained from society and used for society. All of the capital required can be the responsibility of the users of electricity, who are those that benefit, which also means using the method of collecting electricity price surcharges to accumulate capital for technical upgrading for desulfurization in coal-burning power plants and for newly-built desulfurization projects.

Table 6 is a reflection of the range of variation for the increased electricity surcharges for the investments in each of the four desulfurization programs described above (including capital construction investments and operating costs) converted per kWh of electricity. Table 6 shows that the electricity surcharges corresponding to each of the four desulfurization programs range from 0.13 to 0.71 fen/kWh. Collecting this type of surcharge is entirely acceptable.

Collecting electricity price surcharges to accumulate capital to develop new desulfurization technology and make investments in desulfurization projects should start now. This income should be utilized according to the amounts collected and to comprehensive considerations of actual conditions in the regions where it is collected. For regions with relatively concentrated collections and large discharges of SO_2 from coal-burning power plants, this income should be totally concentrated on desulfurization projects at thermal power plants to solve the problems of pollution from big SO_2 dischargers. For regions with relatively decentralized fees and many small pollution sources, this income can be deposited in banks for use as a special fund for construction of desulfurization projects at coal-fired power plants and provided to localities in the form of loans for carrying out centralized

heat supplies, urban coal gasification, and other types of comprehensive control in the environmental protection area. When these control projects are completed, this special fund can still be used for construction of coal-fired power plant desulfurization projects.

The earlier that a program to collect electricity price surcharges is implemented, the more it will benefit capital raising and accumulation and the more it will benefit controlling SO_2 at coal-fired power plants. Besides the feasibility of this program, the difficulties in its huge overall sums involved in desulfurization investments will be decentralized into the problem of small sums of electricity prices to allow all of society to bear the burden of controlling SO_2 pollution. The minute increases in electricity costs to improve the environment will have only a minimal impact on our national economy and the people's lives, so society will be happy to accept it and should accept it.

Table 6. Four Types of Desulfurization Programs Converted Into Increases Each Year in Electricity Prices

	Program							
	1		2		3		4	
	Item							
Year	Investment in desulfurization during year (billion yuan)	Converted to electricity prices (fen/kWh)	Investment in desulfurization during year (billion yuan)	Converted to electricity prices (fen/kWh)	Investment in desulfurization during year (billion yuan)	Converted to electricity prices (fen/kWh)	Investment in desulfurization during year (billion yuan)	Converted to electricity prices (fen/kWh)
1994	-	-	3.88	0.52	-	-	-	-
1995	-	-	4.05	0.50	-	-	1.3	0.16
1996	6.09	0.71	1.99	0.23	2.49	0.29	1.14	0.13
1997	6.38	0.70	1.99	0.22	2.61	0.29	1.19	0.13
1998	6.67	0.70	2.00	0.21	2.73	0.28	1.24	0.13
1999	6.96	0.69	2.07	0.21	2.85	0.28	1.30	0.13
2000	7.25	0.69	2.13	0.20	2.97	0.28	1.36	0.13

Status of Circulating Fluidized-Bed Technology Development

936B0027 Beijing DONGLI GONGCHENG [POWER ENGINEERING] in Chinese Vol 12, No 5, 15 Oct 92 pp 5-11

[Article by Lin Zhaokui [2651 2507 1145] and Wang Dun'en [3769 2415 1869] of the Ministry of Machine-Building and Electronics Industry, Shen Jinru [3088 6651 1172] of the Harbin Boiler Plant, Ruan Yishao [7086 1150 4801] of the Dongfang Boiler Plant, and Tian Ziping [3944 1311 1627] of the Shanghai Power Generation Equipment Set Design Institute: "The Current Situation in Development of Circulating Fluidized-Bed [CFB] Technology in Europe"]

[Excerpt] [passage omitted]

IV. Proposals for Developing CFB Boilers in China

To accelerate the development of CFB boilers, reduce our lag behind foreign countries, absorb experiences and lessons from the frequent ups and downs in the history of China's development of bubble fluidized-bed boilers, the main thing is to undertake scientific research in an organized manner and avoid waste of manpower, materials, and finances caused by repetition at identical levels. For this purpose, we propose:

1. CFB technology is a highly efficient clean combustion technology adapted to a broad range of fuels. Compared to the addition of tailend flue gas desulfurization and denitration devices on conventional boilers, it is cheaper to manufacture and simpler to operate and maintain, and 100MWe generators have attained now attained commercial operation levels in the world. This is a new technology suited to China's national conditions, and the state should formulate the corresponding policies to spur the development of this technology in China.

2. The relevant departments of the state should formulate medium and long-term plans for the development of this new technology to create the conditions for coordinating and organizing S&T forces throughout China to attack key S&T problems, truly motivate initiative in all areas, and organically integrate basic research, engineering research, and technical research. Try to make several takeoffs during the Eighth 5-Year Plan and Ninth 5-Year Plan and place, respectively, 100MWe and 300MWe grade CFB boilers into commercial operation.

3. There are different technical schools for CFB technology, so we advocate allowing 100 voices to contend and 100 flowers to blossom. We can conduct experiments and demonstrations for all different types of CFB boilers. Different fuels and different capacities all have their own appropriate technical requirements, so safety, reliability, economy, high efficiency, and pollution control should be the indicators for checking.

4. Under the unified leadership of the state, companies and groups should lead the way in organizing actual work

in the areas of scientific research, design, and manufacturing, allocate tasks (or solicit bids) according to the quality of work in each unit, and organize them into an integrated whole. The state should provide preference and support in capital loans and development policies. We must establish experimental base areas and develop CFB boilers suited to China's national conditions.

5. Use CFB boiler import projects as a juncture for taking various routes to undertake cooperation with companies in foreign countries. There can be cooperative production, cooperative design, even joint investments, joint development, joint bidding, and so on. State and local government departments should provide support and urging.

6. Along with importing technology, organize digestion and absorption work properly and integrate with our own research to apply them as quickly as possible in the design and manufacturing of Chinese-made generators and make them become a new type of CFB boiler suited to China's national conditions and resources.

Selection of Flue Gas Desulfurization Technology

936B0004A Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese Vol 25, No 8, 5 Aug 92 pp 2-4

[Article by Shu Huifen [5289 1920 5358] and Xu Fenggang [1776 7685 0474] of the Ministry of Energy Resources Safety and Environmental Protection Department: "Desulfurization Technology in China's Thermal Power Plants and Selection of Implementation Programs"]

[Text]

I. Current Sulfur Dioxide Discharge Conditions in China and the Situation We Face

China is a country in which coal is the primary energy resource. Coal accounts for 74 percent of our primary energy resources. Because of the large amount of coal that we burn, the amount of sulfur dioxide (SO_2) discharged into the atmosphere has increased every year. According to an environmental bulletin from the State Environmental Protection Bureau, the amount of SO_2 discharged into the atmosphere from the burning of coal in industry in 1991 was 15.59 million tons. Because we have not adopted control measures, the amount of SO_2 being discharged has tended to increase. Environmental problems created by SO_2 are becoming increasingly acute and acid rain has appeared over a large area in Guangdong, Guangxi, Sichuan, Guizhou, and other regions, and they have now become the third largest acid rain region after North America and Europe. It has caused substantial economic losses in industrial and agricultural production and is directly threatening the normal life of our people. Atmospheric discharges from the electric power industry in 1991 reached 4.60 million tons, equal to 29.5 percent of total SO_2 discharges in China. If we fail to control them, expected SO_2 discharges in 2000 will exceed 9 million tons. The State Environmental Protection Bureau has proposed a national SO_2 control standard of 20 million tons for the year 2000. Allocated on the basis of proportional coal consumption, SO_2 from the electric power industry must be reduced by more than 2 million tons. In regions with serious acid rain problems and dense power source points at the present time, the SO_2 problem has become a restricting factor for electric power development. To achieve sustained and stable development of our national economy, we must also accelerate the pace of thermal power construction in these regions, the selection of power source points must attain an economic scale, and it must satisfy national or local environmental standards so that there is coordinated development of electric power construction and environmental protection. For this reason, the electric power industry faces a serious challenge in the area of controlling SO_2 discharges.

If thermal power plants are to control SO_2, there first of all must be major decisions regarding fuel policies, price policies, and rational deployment of power source points. Examples would include focused support for developing superior-quality coal, restricting the mining of high-sulfur coal, supplying large cities with superior-quality coal, setting coal prices according to quality, and so on. Moreover, measures should also be adopted to control SO_2 discharges. Within the next 8 years, while the electric power industry is developing we must also reduce SO_2 by more than 2 million tons. Although desulfurization costs a great deal, it is essential.

II. Establish Thermal Power Plant Desulfurization Demonstration Projects

In the electric power industry at present, only Luohuang Power Plant has imported two sets of industrial desulfurization facilities and China still does not have an understanding of the manufacturing technology for complete sets of desulfurization equipment. We also lack the capital, so relying on equipment imports to resolve our SO_2 problem does not conform to China's national conditions. Thus, it is necessary that we plan to build two or three thermal power plant desulfurization demonstration projects during the Eighth 5-Year Plan to accumulate experience in the areas of scientific research, design, manufacturing, installation, operation, and management, make a shift to domestic production of the equipment, build desulfurization facilities on a significant scale for the Ninth 5-Year Plan and into the future, control the threat caused by acid rain, and promote development of the electric power industry itself. Although thermal power plant desulfurization will involve large investments and high operating costs, we can only build two or three desulfurization demonstration projects during the next 5 years and the capital required is limited. The increasingly acute acid rain problem has already attracted a high degree of attention at all levels of government and the State Council has convened the 19th and 20th Environmental Commissions for specialized research on collecting SO_2 discharge fees and using the capital raised this way to control the

acid rain problem. This is a major spur to progress in accelerating thermal power plant desulfurization in the electric power industry and will open a channel to provide construction capital for future thermal power plant desulfurization projects.

On the other hand, there is already a substantial work foundation for building two or three desulfurization demonstration projects. During the Seventh 5- Year Plan, Huaneng's Luohuang Power Plant imported two sets of wet method desulfurization devices and technology from Japan and we have an understanding of equipment installation and debugging technology. The Southwest China Electric Power Design Academy, Baima Power Plant, and other units assumed responsibility for a project to attack key S&T problems during the Seventh 5- Year Plan: intermediate testing of rotary spray dry method desulfurization at Baima Power Plant has already passed state examination and approval and received a state commendation. During the 8 year-long experiment, we accumulated preliminary experience in the areas of scientific research, design, equipment manufacturing, installation, debugging, and production operation, and furthermore, all of the equipment was made in China. We trained and tempered a staff that basically has the conditions for expanded application to 100 to 200MW generators. During this period, we gained an understanding of much technical data and provided the necessary scientific basis for building thermal power plant desulfurization demonstration projects. It should also be noted, however, that there is considerable perfection work to be done to shift to larger rotary spray dry method desulfurization facilities. For this reason, we must go through a demonstration project stage before extending and applying these desulfurization technologies. There must also be further digestion and absorption work for the wet method desulfurization facility imported by Luohuang Power Plant to make better preparations for a shift to domestic production.

III. Selection of Desulfurization Technologies for Demonstration Projects

The establishment of a technical line for demonstration projects is in a certain sense representative of China's future investment directions for thermal power plant desulfurization, so selection of demonstration project technologies must be objective and scientific and conform to our national conditions. It should conform to these selection principles:

A. It must have a substantial scope of applications

China has a vast territory and there are rather substantial differences in the sulfur content of coal varieties from each area. Coal used to generate power that has a sulfur content of less than 1 percent accounts for 54 percent, while that greater than 1 percent but less than 2 percent accounts for 36 percent, and that greater than 2 percent accounts for 10 percent, with that greater than 3 percent accounting for just 3 percent. Moreover, each type of desulfurization technology has its own scope of applications. Taking into consideration the acute acid rain problems in high-sulfur coal regions and the fact that they will be the key regions for controlling acid rain in China in the future, consideration should be given to technologies appropriate for high-sulfur coal when choosing desulfurization technologies for demonstration projects. Coal with a sulfur content of 1 to 2 percent that is used for power accounts for the largest proportion, so in considering the coverage area for extension and application we should also select desulfurization technologies that are suitable for moderate and low-sulfur coal.

B. Technical maturity

Demonstration projects are the transition stage from experimental research to industrial applications, so we must certainly select technically mature technologies because we can move forward quickly with mature technologies and there is more experience and information we can borrow from, which helps shorten the schedule for a transition from demonstration projects to industrial applications. At the same time, we must also consider the continuity of desulfurization technology development and the existing work foundation in China from the Seventh 5-Year Plan.

C. Economic pragmatism

Our desulfurization projects cannot be widely applied because their cost is too high. For this reason, if demonstration projects are to become models for future extension and application, they must be required to save capital construction investments, have low operating costs and simple systems, and conform to our national conditions.

Based on the above principles, the following three types of desulfurization technology can be used for desulfurization demonstration projects during the Eighth 5-Year Plan:

1. Limestone-gypsum wet method desulfurization technology

Huaneng's Luohuang Power Plant has already imported two sets of 360MW generator boiler flue gas desulfurization facilities from Japan, and the first set has already been placed into operation. While operating costs in this type of desulfurization technology are rather high, the technology is mature, the equipment operates reliably, the calcium utilization rate is high, as much as 90 percent and higher, and at a calcium/sulfur ratio of 1.2, the desulfurization rate can exceed 90 percent, so it is especially suitable for power plants that burn high-sulfur coal ($S > 3$ percent).

2. Spray drying desulfurization technology

During the Seventh 5-Year Plan, an industrial desulfurization device that can treat 70,000 Nm^3/h of flue gas was completed at Baima Power Plant in Sichuan. This technology is simple and appropriate, and it passed state

examination and approval. Moreover, substantial design and operating experience has been accumulated and there has already been a shift toward complete domestic production. The capital construction investment and operating costs of this technology are lower than wet method desulfurization and at a calcium/sulfur ratio of 1.2 to 1.5, the desulfurization efficiency can reach 78 to 84 percent, so it is suitable for power plants that burn moderate and high-sulfur coal.

3. In-boiler calcium spray and flue wetting activation desulfurization technology

This is a new desulfurization technology developed in foreign countries in recent years and is now in use in several countries. Finland's LIFAC technology has already been commercialized. China has also undertaken considerable research work on it. This technology is characterized by simple systems and lower investments and operating costs. At a calcium/sulfur ratio of 2 to 2.5, the desulfurization rate can reach about 80 percent, so it is suitable for power plants that burn moderate and lower-sulfur coal. To meet the needs of demonstration projects during the Eighth 5-Year Plan, we plan to import this technology from foreign countries.

IV. Thermal Power Plant Desulfurization Must Have Economic Policy Support

Thermal power plant desulfurization involves substantial capital construction investments and high operating costs and has no economic benefit whatsoever for the enterprises themselves. To make enterprises self-consciously assume social responsibility for desulfurization and operate, maintain, and manage desulfurization facilities as well as production facilities and foster their benefits, the state must formulate matching economic policies.

When building new thermal power generators or expanding them, capital construction investments in desulfurization facilities should be included in the budgetary estimates for project construction and made a part of project construction. Estimated operating costs will increase by more than 0.01 yuan per kWh, so we must implement new prices for new power sources and include them in power generation costs, and in the long-term view, we must include desulfurization in electric power development plans to ensure capital for desulfurization construction. Because of the greater increase in operating costs from adding desulfurization facilities at existing thermal power plants, enterprises cannot digest them themselves, so policies should permit upward readjustments in electricity prices to get it from society and create prosperity for society.

Thermal power plant desulfurization takes substantial capital and the formulation of corresponding economic policies is also complicated work. We should start working now to gradually open up channels and open the way for future thermal power plant desulfurization. If we have no economic policies to help spur desulfurization, it will be hard to carry out desulfurization work. The goal in building demonstration projects is to accumulate experience, so we must first of all implement the policies outlined above in the demonstration projects.

V. Accelerate Matching Technology Development and Research for Industrialization of Desulfurization

To enable economical, reliable, and stable operation of desulfurization demonstration projects during the Eighth 5-Year Plan and provide a solid foundation for further extension and application, we must undertake the following matching scientific research work:

1. Research on powdered limestone preparation and lime digestion technology;

2. Experimental research on calcium-based absorbents and additives to increase utilization efficiency and reduce operating costs;

3. Research on comprehensive utilization of desulfurization ash to expand the scope of its applications and solve the problem of providing a way out for desulfurization ash;

4. Formulation of quality standards and the corresponding testing standards for the limestone and gypsum used in flue gas desulfurization;

5. Establishment of the corresponding laboratory miniature desulfurization experiment devices to provide key design parameters for the correct design of desulfurization equipment based on actual conditions in power plants;

6. Research on economic policies regarding desulfurization and formulation of design, installation, and operation regulations for desulfurization and the related evaluation standards.

VI. To Achieve a Shift to Domestic Production of Desulfurization Equipment, There Must Be Full Participation by Equipment Manufacturing Plants

After the demonstration projects, we must achieve a shift to domestic production or a basis on domestic sources for desulfurization equipment. This is essential if we are to reduce construction costs for desulfurization to facilitate its extension and application, so there should be active participation by manufacturing departments in the demonstration projects. There should be conscientious sifting to select equipment manufacturing plants so that the plants that are decided upon have relatively powerful technical strengths and the capability of digesting and absorbing large-scale equipment or similar products and make concerted efforts at cooperation in good faith. For long-term benefits, there should be investments in desulfurization work and the economic interests of several areas must be integrated. Use the demonstration projects to gain an understanding of manufacturing technology and capabilities for a shift to larger scales of desulfurization equipment and provide high-quality desulfurization equipment and products for future construction of desulfurization projects.

Growth in Shanxi Power Industry Recapped

936B0025C Taiyuan SHANXI RIBAO in Chinese 27 Oct 92 p 2

[Article by Bian Xuehai [0593 1331 3189], director of the Shanxi Province Electric Power Bureau: "Combine Transportation of Coal with Transmission of Electricity, Make Shanxi Prosperous, Support Coastal Areas"]

[Text] Since reform and opening up, there have been substantial developments in Shanxi Province's electric power industry. During the 10-year period from 1980 to 1990, there was a 1.46-fold increase in the gross value of output in the electric power industry. Our installed generating capacity increased from 2,380MW to 5,830MW, a 1.45-fold increase. Yearly power output increased from 12 billion kWh to 31.4 billion kWh, a 1.62-fold increase and a yearly growth rate of 10.1 percent, which was higher than the national growth rate of 7.53 percent for the same period. A total of 42.1 billion kWh of electricity was transmitted to other areas, which was equivalent to shipping out 25 million tons of raw coal, and this alleviated the communication and transportation shortage situation caused by shipping coal out of Shanxi. Due to the further fostering of the role of S&T, Shanxi Province's electric power industry leapt up to the new stage of large power plants, large generators, large power grids, high voltages, high parameters, and high degrees of automation during the Seventh 5-Year Plan, thereby preparing the technical and administrative forces for major development during the next 10 years.

While Shanxi Province's electric power power industry has developed substantially, its relatively large number of past debts have prevented it from achieving leading development of the electric power industry. Recently, the Shanxi Provincial CPC Committee and Shanxi Provincial Government used the spirit of Comrade Deng Xiaoping's important speech during his tour of southern China as a basis for integrating with realities in Shanxi Province to suggest an important strategic idea. It is to foster Shanxi's advantages of abundant coal resources and suitable geographic location through concentrated construction of several large pit-mouth power plants to convert coal locally into secondary energy resources and transmit large amounts of electric power to Guangdong, Jiangsu, Shanghai, Beijing, Tianjin, Hebei, and other provinces, municipalities, and autonomous regions. This is an historical breakthrough in the development history of China's electric power industry. Energy resources are a major factor restricting an economic takeoff of our coastal regions. Shanxi's advantage is energy resources, but transportation is a major restricting factor. While the state has adopted a variety of measures to resolve Shanxi's problems in shipping out coal, Shanxi still has large overstocks of raw coal every year that create enormous waste. Developing long-distance power transmission is an effective way to resolve railway shipping problems. If coal is converted to electricity and then transmitted to other areas, it can make better use of our energy resource base area's advantages and support national economic construction, and it can effectively increase the results of coal production and promote economic development in Shanxi Province.

Transmitting electricity from Shanxi to Guangdong and Jiangsu may be within the economical distance for power transmission in both cases. Evidently, by the end of 1985, a total of 32 DC power transmission projects had been placed into operation in the countries of the world. Examples include a 750 kV DC power transmission line in Russia that has a total length of 2,400 kilometers and a 500 kV power transmission line running for a total length of 1,362 kilometers along the coast of the Pacific Ocean in the United States. In China, we have already completed a 500 kV DC ultra-high voltage power transmission line between Gezhouba and Shanghai that runs over a total length of 1,800 kilometers. It has been estimated that from Yangcheng in Shanxi it is 700 kilometers to the northern Jiangsu region and 1,200 kilometers to Shaoguan in Guangdong, both of with are within the possible power transmission distance. Based on projections of electricity prices made by the Ministry of Energy Resources Electric Power Academy in the feasibility research report for transmitting electric power from Shanxi to Jiangsu, if imported generators are used and the unit price for standard coal is 150 yuan per ton, the price of electricity supplied to the grid would be 0.20 to 0.25 yuan per kWh and the electricity price for loan repayment would be 0.35 yuan per kWh. The price of electric power transmitted from Shanxi to Jiangsu and Guangdong would not exceed the price of electricity generated at coal-fired power plants completed in these two provinces during the same period. The concrete idea is that there are areas with abundant water near Nanliu Village and near Shiyuan Village in Beiliu Town, Yangcheng County, Shanxi, and the Yangcheng No 1 Power Plant and No 2 Power Plant could be built at these two locations. Each of the two plants would have a planned installed generating capacity of 2,400 to 3,600MW. There would be 500 kV DC power transmission lines built from both plants, one to Shaoguan in Guangdong and the other to the northern Jiangsu region. At the same time, a power plant with an installed generating capacity of 1,200MW could be built in Hequ County and the Shentou No 2 Power Plant could be expanded by two 600MW generators to increase the amount of power supplied to the Beijing, Tianjin, and Tangshan power grids. After new construction and expansion at the Yangquan No 2 Power Plant and Niangziguan Power Plant, electricity could be transmitted to northern Hebei Province.

It is expected that Shanxi's total installed generating capacity may reach about 20,000MW to 25,000MW by the end of this century. This would include 10,000MW in capacity that would transmit power to areas outside of Shanxi with about 45 billion kWh of electricity being transmitted out each year, which is equivalent to a reduction of 30 million tons in the amount of coal shipped out to other areas. Total annual coal consumption for power generation would be 60 to 70 million tons,

and inferior coal, coal in the process of being washed, powdered anthracite, coal gangue, and so on that is hard to sell to other areas could be digested locally. At that time, total annual coal consumption to generate power would be about 50 million tons greater than in 1981. Calculated at current prices, this item alone could increase Shanxi Province's income from sales of raw coal by 5 billion yuan. Calculating the profit from electricity transmitted to other areas at 0.05 yuan per kWh and generating 2,700 kWh of electricity per ton of coal, the income received could be 130 yuan renminbi. Thus, transmitting power to other areas would increase economic benefits 3.5-fold compared to shipping out coal. After the principal and interest are repaid, transmitting power to other areas could earn Shanxi Province about 3 billion yuan in profits and taxes each year. As the market economy develops, Shanxi Province's second pillar industry—the electric power industry—would certainly be able to contribute to bringing prosperity to Shanxi and its people.

Shanxi's strategic decision to combine the transportation of coal with the transmission of electricity has now received substantial support from the relevant departments of the central authorities as well as the cooperation of coastal areas and surrounding provinces and cities. The investment will be raised jointly by the state, Shanxi, and the provinces that will receive the power. Imported investments, repayment of principal and interest via electricity prices, issuance of electric power construction bonds, issuance of various types of shares, exports of coal and coke, and other foreign exchange earning and existing capital raising channels will be employed. By conscientiously adhering to the spirit of Deng Xiaoping's talks during his tour of southern China and resolutely carrying out reform and opening up, Shanxi Province's strategic goal of transmitting out large amounts of electric power can certainly be achieved and Shanxi will play an even greater role as China's energy resource base area.

State Approves 600MW Expansion of Daban Power Plant

93P60081 Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 26 Nov 92 p 1

[Abstract] The State recently approved the expansion project for the Ningxia Daban power plant—a major national construction project. The first stage of the 240MW Daban power plant involved the installation of two 300,000-kilowatt units; these are already operational. The second phase also involves the installation of two 300,000-kilowatt units and will be built in conjunction with the development of the Lingwu coal field. As part of this project, a 330kV line from Daban to Guyuan will be built and a 300kV substation constructed in Guyuan which will link up with the northwest grid.

The entire project will cost some 1.17 billion yuan to be evenly split between the State Energy Investment Company and Ningxia Province.

According to the Ningxia power authorities, construction on the second stage of Daban will begin in 1993 and power is expected to be generated in 1995.

Taiyuan No. 2 Power Plant Expansion

936B0025A Taiyuan SHANXI RIBAO in Chinese 1 Nov 92 p 1

[Article by Yang Zhigang [2799 1807 0474] and Luo Jinqing 3157 2516 3237]: "Taiyuan No 2 Power Plant Has Expansion Project Loan"]

[Text] To bring about the important decision formulated by the Shanxi Provincial CPC Committee and Shanxi Provincial Government to shift from transporting coal to transmitting electricity, Taiyuan No 2 Power Plant and Taiyuan City Construction Bank signed a document of intention on 23 October 1992 for a 390 million yuan loan.

Shanxi Provincial vice governor Wu Junzhou [0702 0193 3166] attended the signing ceremony.

The fourth phase expansion project at Taiyuan No 2 Power Plant is a key construction project. The Third Electric Power Construction Company is responsible for its construction and began construction in December 1991. It must place the first generator into operation within 24 months. A tacit agreement of coordination between the two parties has enabled problems in construction to be overcome. In 9 months of progress at the project, part of the A, B, and C axle bolts and frameworks in the main plant building have been completed according to the original plan and the 210 meter-tall smokestack has been poured to about 100 meters. Construction on the fuel system, hydraulic system, chemical water system, office building, and other facilities is now proceeding smoothly. To accelerate progress in the project, the Taiyuan City Construction Bank accepted a loan application for 390 million yuan for this project and leaders from both parties signed the document of intention on the morning of 23 October 1992.

Work Begins on 1,400MW Yushe Plant

936B0025B Taiyuan SHANXI RIBAO in Chinese 1 Nov 92 p 1

[Article by Shang Jinsheng [1424 2516 3932], Yang Shuxiang [2799 5486 0686], and Jin Wenhui [6855 2429 6540]: "Construction Starts at Shanxi Huaneng Yushe Power Plant on 31 October 1992"]

[Text] A grand ceremony to begin construction of a key state construction project—Shanxi's Huaneng Yushe Power Plant—was held on 31 October 1992. Shanxi Provincial vice governor Ji Xinfang [4764 7451 5364] and leaders from the Huaneng Group Company and other relevant departments spoke at the ceremony.

Yushe Power Plant is the first power plant to be built via a joint investment by the Huaneng Group Company and

Shanxi Province as well as the first project in Shanxi Province to study and adhere to the spirit of the 14th Congress of the CPC Central Committee in implementing the strategic decision to shift from transporting coal to transmitting electricity and to combine development of coal and electric power. This power plant will have a total installed generating capacity of 1,400MW and will be completed in three stages. The first phase project will have two 100MW generators and associated projects for the power plant at a total investment of 580 million yuan. Huaneng Group Company and Shanxi Province are each investing 50 percent. The first phase of the project will implement four types of contractual responsibility for the total investment, the construction schedule, quality, and the formation of power generating capacity. The Shanxi Province Fourth Electric Power Construction Company is responsible for the power plant project.

New Railway Construction To Give Big Boost To Coal Exports

936B0023A Beijing RENMIN RIBAO in Chinese 27 Oct 92 p 1

[Article by reporter Xiao Jiabao [5618 1367 0202]: "Construction Begins on a New Railway Route To Transport Coal from West to East China, Beginning in the West at Shenfu Dongsheng Coal Field and Running East to Huanghua for a Total Length of Over 820 Kilometers, China Starts Another Big Project for the Westward Shift of Its Energy Resource Strategy"]

[Text] The State Council has approved construction of a new railway route to transport coal from west to east China (also called the second railway route), another major construction project in China coming after the Da-Qin [Datong-Qinhuangdao] Railroad.

In his report to the 14th Congress of the CPC, comrade Jiang Zemin made this route along with the Three Gorges project, transferring water from south to north China, and the 10 million ton-grade iron and steel base area China's huge trans-century projects.

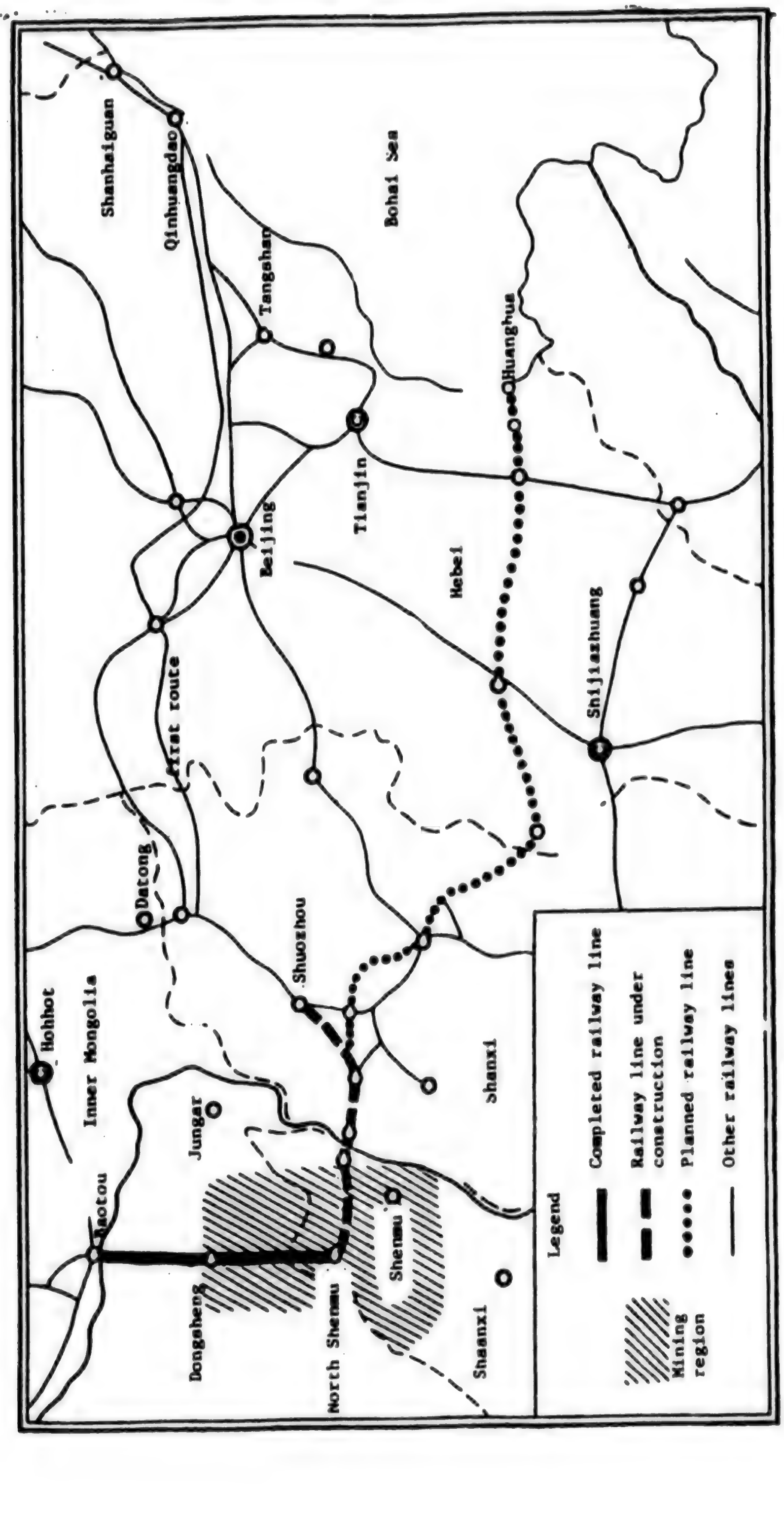
The new railway route starts in the west at Shenfu Dongsheng Coal Field and crosses through Shanxi and Hebei to Huanghua in Hebei on the coast of the Bohai Sea. It will have a total length of more than 820 kilometers and a long-term design annual shipping capacity of 100 million tons, about the same as the Da-Qin Railroad. Moreover, a large new dedicated coal shipping pier will be built at Huanghua. The estimated total investment for the railroad and harbor is 10.7 billion yuan renminbi and the rational construction schedule is 6 to 7 years. Its primary function will be shipping superior quality coal from Shenfu Dongsheng Coal Field. Construction of the segment from Shenfu to Shuozhou, Hebei is now being speeded up.

China's energy resource industry is far from able to meet the development needs of our national economy. One of the most prominent things is insufficient coal supplies, whereas the biggest headache regarding coal supplies is transportation. The second railway route will work in concert with the Da-Qin Railroad and form two energy resource arteries for shipping coal from west to east China, continually shipping out superior quality coal from southern Inner Mongolia, northern Shaanxi, and Shanxi to solve the "coal burning" urgencies of Beijing, Tianjin, Shanghai, and developed regions of eastern China.

The Huaneng Cleaned Coal Company, which is now developing Shenfu Dongsheng Coal Field, said that this coal field crosses the borders of the Inner Mongolia Autonomous Region and Shaanxi and Shanxi Provinces and is close to Shanxi. It now has proven reserves of 23 billion tons, nearly one-third of China's total proven reserves, and is the biggest coal field that has been discovered in China at present. The area has a lot of coal that is also of superior quality and easily mined. The key problem is how to haul the coal out of the area. The first phase project at the coal field has now ended and construction of the second phase is now being speeded up. The second railway route is its most important matching project.

Comrades in the Huaneng Cleaned Coal Company also said that from the development of Shenfu Coal Field to construction of the second railroad route, the old system of departmental separation and segmentation will be broken down and a joint company is now being established to adopt an entirely new development and management system that crosses regions and industries that combines mines, railroads, power, and harbors into an integrated production- supply-marketing entity.

Geographic Location of Mining Region and Coal Shipping Routes



Development of Long-Distance Coal Pipelines

936B0028 Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 10, 25 Oct 92 pp 13-15

[Article by Li Peifang [2621 1014 5364] and Liu Fangpu [0491 5364 0944] of the Tangshan Branch of the Central Coal Science Research Academy: "Development Prospects of Long-Distance Coal Transportation Pipelines in China"]

[Text] **Abstract:** During the past 10-plus years, China built a "Pipeline Coal Transportation Experiment Center" to study pipeline coal transportation technologies. It has proposed over 10 long-distance coal slurry pipeline programs and focused on conducting feasibility research on several large coal transportation pipelines.

Key terms: Pipeline transportation, experimental research, development programs

Coal is the grain of industry. For a considerable period into the future, coal will still dominate China's energy resource consumption. The extremely uneven distribution of China's coal production and sales have made energy resources and communication and transportation two main factors restricting development of our national economy. Solving the transportation problem cannot be delayed.

I. The Distribution of China's Coal Resources and the Current Situation In Railway Transportation

China has abundant coal resources, but they are extremely unevenly distributed and are relatively concentrated in Xinjiang, Inner Mongolia, Shanxi, Shaanxi, and other provinces and autonomous regions. The north China region alone has 61 percent of China's total proven reserves (Inner Mongolia and Shanxi account for 51 percent of China's total reserves). In contrast, the proven reserves in the eight provinces and one municipality south of the Chang Jiang (Hubei and Hunan, Guangdong and Guangxi, Jiangsu, Zhejiang, Fujian, Jiangxi, and Shanghai) account for just 1.8 percent of China's total. Thus, China's future coal development strategy is focused on a gradual westward shift.

China's industrially developed regions are concentrated in our coastal provinces and municipalities and they currently have extreme shortages of energy resources. Northeast China, east China, Hubei, Hunan, Guangdong, Guangxi, Beijing, and Tianjin have become China's main coal shortage regions. The shortages are particularly severe in east China, northeast China, and Guangdong. The real situation determines the serious trends of "shipping coal from north to south China" and "shipping coal from west to east China". It will be hard to change this situation in the foreseeable future. Thus, doing good work on coal transportation is both a requirement for development of the coal industry itself as well as a decisive factor in development of our national economy.

Railways bear the primary burden of shipping out China's coal, and coal haulage has becoming increasingly tight in the past several years. According to statistical data from 1984, coal accounted for 47.3 percent of our total railroad freight volume. It accounted for 60 percent of the total volume of freight on railway trunklines like the Jing-Guang [Beijing-Guangzhou], Jing-Lu [Beijing-Shanghai], Long-Hai [Lianyungang-Lanzhou], Jiao-Zhi [Jiaozuo- Zhicheng], and other primary regional sections. The proportion used to haul coal outside of Shanxi is as much as 90 percent on the Shi-Tai [Shijiazhuang-Taiyuan], Tai-Jiao [Taiyuan-Jiaozuo], Han-Chang [Han-'gan-Changzhi], Tong-Pu [Datong-Mengyuan], and other lines. Even this is far from able to satisfy requirements for shipping out coal. It has been projected that by the year 2000 there will be a net increase of 510 million tons in China's coal output, 350 million tons of which will have to be hauled to other places, so dealing with such a large amount of freight will be a serious problem. According to plans in railroad departments, they plan to build 30,000 kilometers of new lines by 2000, routes will total nearly 90,000 kilometers, and China's projected total railroad freight volume will reach about 1.9 billion tons, nearly double the present amount. At that time, planned coal output will reach more than 1.4 billion tons and the requirements placed on transportation by growth in coal output will be hard for the already extremely tight railroad transportation. We must explore other coal transportation arrangements. Given China's lack of large tonnage high efficiency trucks, poor quality basic highway facilities, and backward management measures, long-distance highway transportation of coal is impossible. For this reason, in the present situation of capital shortages and a continued inability to build new railways and high-speed highways on a large scale, borrowing on experience in pipeline transportation of solid materials in China and foreign countries for active development of pipeline coal transportation is one important way to resolve our shortages of energy resource supplies and communication and transportation as well as an important policy decision to spur development of China's national economy.

II. Developments in Pipeline Coal Transportation Technology

Slurry transportation technology for solid materials is attracting growing attention on a world scale. Because pipeline transportation has advantages like conserving investments, short construction schedules, high economic benefits, small environmental pollution, and so on, the highly industrialized countries with extremely developed communication and transportation are adopting long-distance pipeline transportation to reduce the burden on traditional means of transportation. Starting in the 1950's, the United States built two coal slurry transportation pipelines in succession. One is the (Heimansa) Pipeline in Arizona that has operated continuously up to the present day since going into operation in 1970. It is the only source of fuel for the 1,500MW of generators at Nevada's Mohave Power

Plant. The (Heimansa) Pipeline is 440 kilometers long and has a pipe 457 mm in diameter and a transportation capacity of 4.80 million tons/year. Its reliable operation shows that industrial applications and commercial value of pipeline transportation technology have already attained the mature stage.

There have been new developments in pipeline coal transportation technology in the past decade. On one hand, with major improvements in dehydration technology for common coal slurry (maximum particle size about 2 mm, with particles under 44 μm accounting for about 20 percent by weight), the final product water content of the coal transported by pipeline can be reduced to less than 10 percent and the waste water and waste gas that are discharged completely conform to environmental requirements. This has opened up the way for construction of a new generation of coal transportation pipelines with even greater capacity and longer distances. On the other hand, breakthrough advances have been made in developing technology for high concentration coal-water mixture (CWM), an ideal fuel that can be burned directly in using coal to replace oil, and it is now entering the industrial production and utilization stage. The world's first large-scale CWM transportation pipeline built through cooperation between the Soviet Union and Italy—the Belovo-Novosibirsk Pipeline—is 262 kilometers long, has a pipe diameter of 530 mm, and transports 3 million tons of dry coal annually. It has now gone into trial operation.

During the past several years, many countries have expended large amounts of manpower and materials to conduct experimental research and have proposed plans for developing pipeline transportation. As a modern means of transportation, pipeline transportation is certain to attain widespread use.

III. China's Research on Pipeline Coal Transportation Technology

China has done considerable experimental research and a large amount of preparatory work since 1980 on developing long-distance coal pipeline transportation.

During the Sixth 5-Year Plan, the State Science and Technology Commission and former Ministry of Coal Industry allocated over 4 million yuan to build the "Pipeline Coal Transportation Experiment Center" at the Tangshan Branch of the Central Coal Science Research Academy, and it passed state examination and acceptance in August 1985. This experimental center has attained international levels of the present day in scale, capabilities, and technology, and it is capable providing the main parameters for feasibility research on industrial coal transportation pipelines and provides a base area for experimental research on pipeline coal transportation technology.

The experimental center has structures covering a total area of 3,534 m^2 and is composed of a physics and chemistry laboratory, slurry preparation system, pipeline transportation system, monitoring and control and data collection and analysis system, dehydration system, and other parts. It is outfitted with a variety of precision measurement instruments that can do precision measurement and analysis of the physical, chemical, and flow variation characteristics of the solid materials and slurry being transported. It is outfitted with three wet rod slurry grinding experiment lines with hourly slurry preparation capabilities of 150, 1,000, and 5,000 kg, respectively, that can carry out experimental research on rational parameters for mineral grinding slurry preparation techniques. It has seven experimental pipelines with piping having internal diameters of 44, 76, 100, 150, 204, and 306 mm, respectively. These include a 150 mm diameter outdoor pipeline 1,430 m long that can be used for several simulation experiments on pipeline transportation parameters. The slurry weight concentration can exceed 70 percent and the maximum experimental flow rate is 1,000 m^3/hour. The primary physical measurements during the pipeline transportation experiments are converted by transducers into electrical signals that are remotely transmitted to the center's control room, where microcomputer data collection and analysis systems process them. The coal slurry dehydration system is configured with a large plate-frame filter press that is used to dehydrate the coal slurry in pipeline transportation experiments.

To promote the development of long-distance pipeline coal transportation technology in China and strengthen experimental research work, the Tangshan Branch of the Central Coal Science Research Academy has established a Pipeline Transportation Institute. The primary technical forces in the Pipeline Transportation Institute have been involved in research on the hydraulic transportation of coal for 30 years and have the experimental research capabilities and rich experience for long-distance pipeline coal transportation technology. For over 10 years, they have selected and sent research personnel on several occasions to the United States, Japan, Germany, Italy, England, Holland, Canada, the former Soviet Union, and other countries for inspections, work, or advanced studies, and they are relatively familiar with the development situation for pipeline transportation technologies in all countries of the world. In the past several years, based on deployments made by higher levels, this institute has actively conducted experimental research on several pipeline transportation projects and made important achievements.

During the Sixth 5-Year Plan, the institute cooperated with Qinghua University in completing a task to attack key S&T problems assigned by the State Science and Technology Commission on "Experimental Research on the Physical and Chemical Characteristics and Pipeline Transportation Parameters of Coal Slurry from the Southeast Shanxi, Jungar, and Yanbei Regions" and effectively cooperated with the Petroleum Pipeline Design Academy, Wuhan Coal Design and Research Academy, and Beijing Coal Planning and Design Academy to conduct feasibility research work on the Changcheng [Great Wall] (Jungar to Qinhuangdao),

Chang Jiang (southeast Shanxi to Yizheng), Meixian-Shantou, and other long-distance coal slurry pipelines and provided basic data or design foundations for them.

During the Seventh 5-Year Plan, the institute assumed responsibility for three state projects to attack key S&T problems: 1) CWM pipeline transportation technology. Through experimental research on high concentration CWM storage, pumping, and pipeline transportation characteristics, it provided valuable experimental data for the engineering designs in CWM applications. 2) CWM production technology. With cooperation from a fraternal unit, the Huamei [China Coal] Integrated CWM Technology Center, it assumed responsibility for studying on-line monitoring and control technology for CWM plants and made research achievements that "were pioneers in China and attained world levels". 3) Applications of pipeline transportation at chemical mines. With major support from the Ministry of Chemical Industry's Chemical Mining Bureau and the Chemical Industry Mine Design and Research Academy, the institute spent over 3 years of arduous efforts in comprehensively completing its research tasks on "Semi-Industrial Experiments on Long-Distance High-Concentration Pipeline Transportation of Yichang Refined Phosphate Ore". Appraisal by pipeline transportation experts organized by the Ministry of Chemical Industry felt that this research achievement had attained international levels.

Since the Eighth 5-Year Plan began, the State Science and Technology Commission has included coal slurry pipeline transportation among its projects to attack key problems in clean burning of coal. At present, the institute is establishing a high-concentration CWM pipeline experiment center based on arrangements made by the China Unified Distribution Coal Mine Corporation's Huamei Integrated CWM Technology Center that will serve as an important part of the "CWM Technology Engineering Center" whose establishment has been approved by the state and provide the required measures for further R&D on high-concentration slurry pipeline transportation technology and equipment.

In addition, the institute has also conducted slurry pipeline transportation experiments for metallurgical, chemical industry, electric power, and other departments and has provided reliable bases regarding the design of pipeline projects.

IV. Development Prospects for Pipeline Coal Transportation in China

For more than 10 years, China has been doing a great deal of work to promote the construction of pipeline coal transportation projects. First, it established the China Pipeline Coal Transportation Experts Group to conduct full discussions on the construction of coal transportation pipelines. It has organized a large number of specialized technical personnel in several design and research units in coal, petroleum, metallurgical, and other departments to conduct wide-ranging research on the basic conditions for developing pipeline coal transportation such as coal sources, water sources, and users, and it has obtained large amounts of reliable data and provided program ideas for possible construction of coal transportation pipelines. It has also cooperated independently with pipeline engineering companies in the United States, Italy, the former Soviet Union, and other countries to conduct feasibility research on over 10 pipelines. This series of work has clarified the basic conditions for China's development of pipeline coal transportation, trained and tempered a specialized scientific research and design staff, gained a basic understanding of pipeline coal transportation technology, and laid a foundation for developing pipeline coal transportation.

Now, to alleviate our communication and transportation shortages, the relevant departments are organizing experts in all areas to take action in formulating comprehensive transportation system programs to coordinate the development of a variety of transportation arrangements for construction in China. The medium and long-term communication and transportation S&T development program for China formulated by leaders in the State Science and Technology Commission 3 years ago proposed the strategic objective of developing pipeline coal transportation. By the end of this century, we will complete long-distance coal transportation pipelines with an annual coal transportation capacity of more than 30 million tons and further expand the scale of pipeline coal transportation on the basis of improving pipeline coal transportation technology levels and economic results, and by the year 2020 we will achieve the objective of yearly coal transportation in excess of 100 million tons. At that time, coal pipelines will be an organic part of China's comprehensive transportation system and will play an important role in hauling coal out of our key coal producing regions. Construction of the national economy during the Eighth 5-Year Plan has now spread out in a comprehensive way and the relevant ministries, commissions, and offices of the State Council are coordinating their activities and actively organizing experts in scientific research, design, and equipment departments to hold project establishment discussions for coal slurry pipeline projects to turn long-distance coal transportation pipeline plans into reality. As development of our national economy rapidly increases demand on communication and transportation, the prospects for China's development of pipeline coal transportation are extremely broad.

10-Million-Ton Huolinhe Mine Completed

936B0014A Beijing RENMIN RIBAO in Chinese 25 Sep 92 p 2

[Article by reporter Liu Xieyang [0491 3610 7122]]

[Text] The second-phase 7-million-ton engineering project for the Chinese-designed large-scale open-pit Huolinhe coal mine is coming on line. Combined with

the first-phase project, it raises the scale of the whole mining district to 10 million tons.

Huolinhe mining district is a national key construction project, one of the largest open-pit mines in China. The first-phase 3-million-ton project became operational early in 1984, and the second-phase project, more than double the size of the first, was begun in 1989.

Construction activity has intensified at the Hunchun coal mine, located in the Yanbian Chaoxianzu Autonomous Prefecture of Jilin, where a pair of mine shafts are already operating, producing over one illion tons per year.

The Hunchun coal mine, situated in the "Golden Triangle" of the Tumen River, is a large mine on the northeast frontier of China where large-scale extraction formally began in the 1980s. To support the construction of the golden triangle, the Inner Mongolian Coal Industry Corporation dispatched more than 10,000 workers from Jilin's Wenhe coal mine to build the 900,000 ton-per-year Yingan coal mine, and the Chengxi coal mine, which has an output of 750,000 tons per year. They are now working on the Baliancheng and Banshi mines.

Mining district authorities say there are over 800 million tons of geological reserves at this coal field, that it can supply coal for about the next 100 years, and that its main product is long-flame coal. This large coal field will provide strong support for the economic development of the golden triangle.

China's Petroleum Industry: Prospects and Concerns

936B0019A Beijing LIAOWANG ZHOUKAN [LIAOWANG WEEKLY] in Chinese No 42, 19 Oct 92 pp 16-18

[Article by Li Yongzeng [2621 3057 1073]: "Prospects and Concerns of China's Petroleum Industry"]

[Text] After 30 to 40 years of stable development, Mainland China's petroleum industry has now become an important industry that supports rapid development of the national economy. During the 1960's, the history of China's reliance on petroleum imports came to an end. In the 1970's, it began exporting. In the 1980's, yearly petroleum output surpassed 100 million tons and it moved into the ranks of the world's big petroleum producing nations. Entering the 1990's, China's annual petroleum output has consistently held steady at more than 130 million tons, fifth place in the world. Recently, the China Petroleum and Natural Gas Corporation met with reporters to inform them of the petroleum production situation in 1992, and the overall assessment is still encouraging.

I. Oil and Gas Production Completed in Excess of Plans

In 1992, several oil fields suffered serious natural disasters. In the early part of the year, for example, Jiangsu Oil Field experienced a severe spring freeze, in July the Shaan-Gan-Ning [Shaanxi-Gansu-Ningxia] region was hit by thunderstorms that had not been seen in many years, and in August the Bohai Bay region, in particular Shengli Oil Field, was hit by storm tides that had not been seen in 50 years. However, total oil and gas output in China surpassed plan quotas every month and total crude oil output from January through September surpassed 100 million tons, an increase of 800,000 tons in oil output over the same period during 1991. Projected oil output during all of 1992 may reach 133 million tons, which is 800,000 tons more than state plans. Total natural gas production from January through September was 11.3 billion cubic meters and gas output during all of 1992 is expected to reach 15.1 billion cubic meters, which is 200 million cubic meters more than state plans.

In a situation of entering high water content and extra-high water content development, the oil fields of eastern China have comprehensively extended Daqing Oil Field's experience in controlling water and stabilizing oil output, with significant results. During 1992, the total water content at Daqing Oil Field increased by just 0.4 percent and the total water content in China as a whole increased by 0.69 percent, so a way has been found to stabilize production at old oil fields.

In western China, especially in the three large basins of Xinjiang, three new oil fields with a yearly output capacity of 2.5 million tons have been completed and placed into production at Xazgat, Lunnan, and Shanshan. In addition, preparatory work has been completed for comprehensive development of three new oil fields at Qiuling, Donghe, and Cainan and it is expected that they may form a yearly production capacity of 3 million tons in 1993. Projected oil output from Xinjiang's three basins in 1992 is 8.74 million tons, an increase of 970,000 tons over 1991.

Two breakthroughs have been made by relying on technical progress. One is that dense oil output in 1992 may surpass 10 million tons, up by 1 million tons over 1991. The second is that increased output from well operation measures during 1992 may surpass 10 million tons and attain the highest level in the past 5 years.

While continuing to import advanced technology from foreign countries, the petroleum industry has also actively entered the international market. For example, it has obtained extraction rights for extractable reserves of 2,284 cubic meters of ultradense oil in the Athabasca region of Canada's Alberta Province; it is now cooperating with nine large international petroleum companies to attack key problems in oil sand extraction technology; it has made a joint investment to purchase a small oil field in California in the United States; it is now negotiating evaluation services for cooperative oil field development with Peru, and so on.

II. New Advances in Exploration Projects

The advances made in exploration projects during 1992 are better than previous years and the pace and time of engineering advances has been synchronized. From January to August, a total of 78.2 percent of the annual plan for two-dimensional seismology and 67.6 percent of three-dimensional seismology has been completed, as has 71.1 percent of the annual plan for exploratory drilling and 67.3 percent of the exploratory drilling driving footage.

Intensive exploration of old regions in eastern China has produced several new oil-bearing regional blocks that provide domains for energy production construction. Substantial reserves have been obtained in the Yushulin region at Daqing, the Xinmiao region in Jilin, the Lengjiapu region at Liaohe, and around old regions at Shengli and Dagang. Proven reserves in excess of 10 million tons have also been obtained in old regions at the North China, Zhongyuan, Jidong [East Hebei], and other oil fields. At the same time, several new achievements have been made in shallow sea regions of Bohai Bay and there have also been new discoveries made in the new basin around its periphery.

Several important achievements have been made in exploration of Xinjiang's three large basins in western China, and they reveal the enormous potential for finding large and medium-sized oil and gas fields. Besides evaluative exploratory drilling in the Jirak, Jiefang Qu [Liberation Canal] East, Sangtam, Lunnan, and other oil fields that has produced some reserves, preliminary exploration has also produced four new discoveries: 1) A breakthrough has been made in Donghe sandstone at the Tazhong-2 [central Tarim] well with a

tested daily output of 285 tons of oil and 52,000 cubic meters of natural gas and structural traps that enclose an area of 123 square kilometers. Three rows of local structures covering a total area of 836 square kilometers have now been discovered in the central region of the basin, and it is a favorable region where large oil fields may be found. 2) High-output oil and gas flows were obtained from the Tertiary system on the Dirgen West structure with daily outputs of 108 cubic meters of condensed oil and 25,600 cubic meters of gas. 3) An oil-bearing structure has also been discovered in the Dongketang region. The Donghe-4 well produced a daily output of 76 tons of oil from oil strata 33 meters thick and projections indicate that it may control over 1 million tons of petroleum reserves. 4) Gas-bearing structures have been discovered in the Caohu region, including the No 2 well which discovered a variety of types of gas strata over 30 meters thick in Donghe sandstone. This region will become an important natural gas exploration region.

Intensive exploration continued during 1992 in four primary structural zones in Turpan-Hami Basin and achievements made there have drawn attention. The most important achievement in Junggar Basin is the discovery of oil and gas strata with extremely great potential in the central region covering 53,000 square kilometers.

Substantial advances have been made in natural gas exploration in the central part of Shaan-Gan-Ning Basin. Proven geological reserves in the central region were turned over to authorities and received their approval in 1992. Evaluative exploration on the southern and northern sides has also basically proven a gas-bearing area of 1,420 square kilometers. Two wells in the prospecting region in the southern part produced industrial gas flows that initially control a gas-bearing area of 600 square kilometers. Gas strata and gas indications have also been seen in the prospecting region in the northern part and it is expected that the gas-bearing area may be substantially expanded.

There have also been new discoveries in natural gas exploration in Sichuan Basin. Two gas fields have already been proven and four gas-bearing structures have been discovered in 1992. Exploration in the Datianchi structural zone has progressed rather quickly. It is expected that the gas-bearing scale of the entire structural zone may reach 100 billion cubic meters from the end of 1992 to the first quarter of 1993.

III. Making Full Use of International Petroleum Resources

While there have been new increases in output each year in the petroleum industry, these output increases are far from sufficient relative to the needs of our rapidly growing national economy. Since the mid-1980's, the annual rate of growth in crude oil output has consistently tended to decline each year. During the past 4 years, the annual increases were just a few 100,000 tons. For a petroleum producing superpower with yearly output of more than 100 million tons, this small growth is far from able to satisfy our requirements. On the one hand, petroleum production cannot move forward and on the other hand petroleum consumption continues to grow. As time passes, this will inevitably have an impact on normal development of our economy. Recently, LIAOWANG ZHOUKAN invited 10 experts and scholars to a special discussion of this problem.

The experts pointed out that, based on the original plan to double our national economy during the 1990's and calculated at an elasticity coefficient of 0.6 for energy resources, total demand for petroleum in China by the end of this century will be at least 200 million-plus tons. Can our domestic petroleum production and existing resources guarantee this? The answer is no. Calculations by experts in the China Petroleum and Natural Gas Corporation show that, extrapolating on the basis of exceeding the pace of state plans, the maximum crude oil output in China by 1995 will be about 150 million tons. To meet the demand, we must increase output by at least 10 million tons of crude oil a year over the next 5 years. Looking over the development history of petroleum in China, there were only 3 years when output increased by 10 million tons a year. One was 1974, when Daqing's Lamadian Oil Field went into development. The second was 1976, when North China's Renqiu Oil Field was developed. The third was 1984, when there were major discoveries at Shengli Oil Field. Based on reserves now in hand, it is completely impossible to increase crude oil output by 50 million tons in 5 years.

The main reason that increases in crude oil output have fluctuated at a low speed is that all of the primary oil fields in east China have entered the later periods of development. A few years ago, the average water content at all of China's oil fields was about 67 percent, which is about 2 tons of water per 1 ton of oil. The water content has already risen to about 81 percent in 1992, so extracting 1 ton of oil carries with it over 4 tons of water. To maintain the present production situation, we would have to inject over 700 million tons of water each year. Rising water contents in oil fields have now led to a universal decline in output in old oil wells and the decline has occurred simultaneously not in several 100 wells but in several 10,000 wells.

Our original proven reserves are gradually disappearing and our new reserves cannot replace them. Exploration work is also becoming increasingly difficult and nearly all of the easily-found portion has been completely located. The conditions for the remainder are very arduous. West China is a huge desert and east China has mountains and shallow seas, so costs are higher and more work is required. Although we have abundant resources, it will be hard to make major discoveries in the short term.

Obviously, simply relying on domestic production cannot meet our economic development requirements. The experts attending the meeting pointed out that we

must open our field of view by developing and utilizing both domestic and foreign resources and the domestic and foreign markets. In the near term, we must find ways to reduce exports and expand imports. When China started exporting crude oil in 1973, we began by exporting 10 million tons to Japan. The highest year was 1985, when we exported 32 million tons, and it has dropped to 21 million tons in 1992. Petroleum exports have made a great contribution to our nation's development of foreign trade and during the period of our greatest foreign exchange earnings from petroleum they accounted for 20 percent of our total export trade volume. This fell to 8 percent in 1991. During the past few years our domestic oil refining capacity has grown very quickly and many oil refineries have insufficient supplies of crude oil. For this reason, several provinces in southern China have taken the lead in importing crude oil. At present, however, our exports still exceed our imports. It would seem that increasing crude oil imports is inevitable. Some experts have predicted that by 1995, China may change from being a net exporter of crude oil to a net importer.

All of the world's developed countries have put the establishment of stable petroleum supplies in an important position. The United States' imports of petroleum account for 50 percent of its total consumption. This figure is 70 percent for the countries of Europe, and Japan relies 100 percent on imports. Based on internationally accepted figures, China has extractable reserves of over 10 billion tons of oil and over 6 trillion cubic meters of gas. We rank 37th and 41st, respectively, in per capita extractable reserves and the amounts of resources available per capita are just one-ninth the world average levels. To support economic construction in a country with a population of 1.1 billion people, China must also establish its own stable petroleum supplies on a world scale.

IV. Opening Up and Reform Are Essential

China is extremely poor in per capita resources, but we also have serious waste in petroleum consumption. Statistics indicate that China directly burned over 38 million tons of oil in 1978, equal to 36.8 percent of our total crude oil output during that same year. In 1981 China adopted the policy of substituting coal for oil and comprehensive reduction of oil burning. There was some reduction in the proportion of oil burned directly by 1985 but the absolute amount was still as much as 30 million tons, 70 percent of which was used in industrial furnaces and kilns and burned up as a regular fuel.

In 1990, Japan had over 53 million automobiles that consumed 33 million tons of gasoline. In the same year, however, China had a total of 5.4 million-plus automobiles, just one-tenth the number in Japan, but our gasoline consumption was 19 million tons, more than one-half the amount in Japan. Energy consumption per unit of output value in China is 5.4 times that in Japan, 3 times that in the United States, and even 2 times that in India.

The experts point out that one of the main causes of our serious waste in petroleum consumption is our long-term policy of low prices for oil. China's petroleum prices have consistently been far below oil prices on the international market. After several readjustments, the selling price per ton of oil within plans rose from over 70 yuan to over 100 yuan and has now reached 200 yuan. Extrapolated at present levels, however, the price of oil on the international market is equivalent to about 900 yuan renminbi.

The policy of low oil prices has also resulted in serious losses in petroleum enterprises. They are unable to develop and lack reserve strengths. From 1988 to 1991, Daqing Oil Field had after-tax losses for 4 consecutive years and total losses exceeding 2.1 billion yuan. The cost per ton of oil at North China Oil Field has risen to 473 yuan. If it was sold at oil prices within plans, they would lose over 270 yuan per ton by selling it. Prices for crude oil are low, but prices for natural gas are even lower. North China Oil Field supplies Beijing with 80 million cubic meters of natural gas a year and its losses total 30 million yuan.

Petroleum extraction is a resource-type industry, so as the resource is gradually depleted, the cost of extraction rises. Forecasts by relevant departments indicate that if all crude oil prices in China attained the highest oil price levels in China at the present time, which would be 500-plus yuan per ton of oil, there would still be seven oil fields in 1993 that experienced losses and this would increase to 10 oil fields by 1995. In input/output terms, if the entire industry had incomes no lower than costs starting in 1993, the shortage would reach 9 billion yuan in 1995. Based on the extent of price increases at present, the average cost of crude oil in China in 1998 will reach or surpass the international price for oil at that time. In a situation of a sluggish economy during 1991, over 100 of the 500 largest corporations in the United States suffered losses but all of the large petroleum companies had profits, including the Atlantic-Richfield Company which had profits of $5.6 billion, the profit leader among the 500 largest corporations. Why is it that most petroleum enterprises in foreign countries have profits while China's petroleum industry is facing industry-wide losses?

Some experts point out that in the overall sense, the most fundamental reason that China's petroleum industry has fallen into such difficult straits today is that during the 10-plus years of reform and opening up, the petroleum industry has still basically adopted a planned management model and has not boldly implemented the reform of depending mainly on the market as a guide in the petroleum industry, which has created unfavorable external and internal conditions for petroleum industry enterprises.

One of the main shortcomings of macro policies is that management of the petroleum industry does not use the world market as a background and results as the center for organization and design. It still focuses on material

amounts: petroleum and natural gas output, amount of exploration work, and proven reserves. Very little consideration is given to costs, benefits, and so on. Neither is there consideration for the greater economy of domestic petroleum supplies and imported petroleum. To complete the annual production plans assigned by the state with the international market price of crude oil at 900 yuan renminbi per ton, some oil fields have been forced to use oil at the high cost of 1,000 to 2,000 yuan per ton to complete their 100,000 ton plans. In other words, it is much cheaper for them to buy oil than it is to extract crude oil themselves. The rigidity and lack of results of the planning system are extremely acute in development of the petroleum industry.

The unanimous view of the experts is that the basic way out for China's petroleum industry is still to accelerate the pace of reform and opening up.

Technology Provides Breakthrough for Oil and Gas Fields

936B0019B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 16 Oct 92 p 2

[Article by reporter Li Gang [2621 6921]: "News of Victory Pouring In from Petroleum Industry, Major Breakthroughs for S&T Progress at Oil and Gas Fields"]

[Text] An official in the China Petroleum and Natural Gas Corporation told reporters on 15 October 1992 that there have been successive victories and ever-growing technical progress at present in China's petroleum and natural gas exploration and production, and that the pace of opening up to the outside and cooperation is being accelerated.

According to the information, in a situation in which eight oil fields suffered serious natural calamities during 1992, oil and gas output still surpassed planned quotas every month, with oil output from January to September up by an additional 800,000 tons compared to the same period in 1991, reaching 103.61 million tons, and natural gas output of 11.3 billion cubic meters.

Especially interesting was that two major breakthroughs may be made in S&T progress at oil and gas fields. One is that condensed oil output may surpass 10 million tons, up 1 million tons over 1991. The second is that well operation measures have been strengthened and that new additions to output surpassed 10 million tons and attained the highest level in 5 years.

New achievements have been made in continually extending and applying new technologies. The application of high-precision electronic pressure gauges and other technologies for detecting the characteristics and potential of oil pools has raised scientific decision making levels in oil field development and readjustments of deployments. Low permeability oil strata extraction technology has been further matched up, there have been continual improvements in overall pressure cracking technical levels, and there has been a excellent beginning in slanted drilling technology. The application of the new slanted drilling technology alone is expected to increase crude oil output by 50,000 tons during 1992.

Petroleum exploration has made major efforts to extend three-dimensional seismology, numerical simulation, and other advanced technologies that have produced several major achievements in exploration in the three large basins in Xinjiang in western China and several new oil-bearing regional blocks have been won in eastern China. The achievements in natural gas exploration are even more gratifying and it is expected that the reserves proven by the end of 1992 may be 5 times the state plan.

While China's petroleum industry has continued to import advanced technology from foreign countries, it has also moved outside of our national gates and used technology and trade cooperation as a way to participate in international petroleum resource exploration and development. It has now obtained extraction rights in a condensed oil region in Canada and has made a joint investment to purchase a small oil field block in California in the United States. It has also cooperated in development of oil sand extraction technology and so on with nine of the world's large petroleum companies.

Prospects of Offshore Petroleum Industry Reviewed

936B0026A Beijing ZHONGGUO NENGYUAN [ENERGY OF CHINA] in Chinese No 10, 25 Oct 92 pp 1-3

[Article by Shi Ban [4258 2432] of the Ministry of Energy Resources: "Review and Development of the Offshore Petroleum Industry"]

[Text] China's offshore petroleum exploration work began in 1957. At that time, the Ministry of Petroleum Industry, Ministry of Geology, Chinese Academy of Sciences, and other units did gravitational and magnetic surveys and some geoseismic measurement work in the Yingge Sea, Beibu Gulf, Zhujiangkou [Pearl River mouth], Bohai Sea, Yellow Sea, and other marine areas. Units under the jurisdiction of the Ministry of Petroleum Industry drilled 110 exploratory wells in the Bohai Sea, Beibu Gulf, and Yingge Sea. They discovered nine oil-bearing structures and three offshore oil provinces in the Bohai Sea located at Hai-4, Chengbei, and 428-West. Units under the jurisdiction of the Ministry of Geology and Mineral Resources drilled 14 exploratory wells in the southern Yellow Sea and offshore area at the mouth of the Zhu Jiang, one of which produced an industrial oil flow.

With approval by the state in 1979, the Ministry of Petroleum Industry began signing agreements with petroleum companies in foreign countries to conduct marine geophysical surveys in the South China Sea and southern Yellow Sea. A petroleum contract was signed through bilateral negotiations with petroleum companies from Japan and France in 1980 for the Bohai Sea and Beibu Gulf in the South China Sea. In January 1982, the

State Council issued the "People's Republic of China Regulations on Cooperation With Foreign Countries To Exploit Marine Petroleum Resources" and gave the China Marine Petroleum Corporation complete responsibility for cooperation with foreign countries to exploit marine petroleum. Based on provisions in the "Regulations", the China National Offshore Oil Corporation began carrying out three rounds of soliciting bids in 1982 for the southern Yellow Sea, the Pearl River Mouth in the South China Sea, Yingge Sea, Beibu Gulf, and other marine areas. By the end of 1990, the China National Offshore Oil Corporation had signed 58 petroleum contracts and agreements with 45 petroleum companies in 12 countries and regions including the United States, England, Japan, France, Italy, and others. The sea area involved in cooperation covers 310,000 square kilometers, about one-third of the area along China's coastal continental shelf (at water depths of 200 meters and less). Petroleum companies in foreign countries have invested a total of $2.39 billion in exploration capital and $570 million in development capital. The geological petroleum reserves at Liuhua 11.1 discovered in cooperation with the Amoco Corporation in the United States exceed 200 million tons, making it the largest oil province found so far in China's seas. Cuicheng 13-1 discovered through cooperation with the Amoco Corporation in the United States is the largest gas field discovered offshore at present, with proven natural gas geological reserves of 90 billion cubic meters.

At the same time, the China National Offshore Oil Corporation and Ministry of Geology and Mineral Resources have undertaken their own exploration in Liaodong Bay in the Bohai Sea and the East China Sea. The China National Offshore Oil Corporation discovered the Jinzhou 20-2, Suizhong 36-1, Jinzhou 9-3, and other oil fields in Liaodong Bay as well as other geological structures. Among them, Suizhong 36-1 oil field has proven petroleum reserves of 120 million tons. The Ministry of Geology and Mineral Resources discovered three oil and gas fields at Pinghu, Baoyunting, and Canxue (Huangyan 7-1) offshore from eastern Zhejiang during the Seventh 5-Year Plan. Among them, Pinghu oil and gas field has natural gas geological reserves of 26 billion cubic meters.

By the end of 1990, China had completed 610,000 kilometers of seismic measurement lines, drilled 300 exploratory wells, and discovered and confirmed 63 oil and gas-bearing structures. Assessments of reserves in 39 structures produced 713 million tons in petroleum reserves and 130 billion cubic meters of natural gas reserves, equal to 2.7 percent of the petroleum resources and 0.9 percent of the natural gas resources projected for China's coastal continental shelf.

When the China National Offshore Oil Corporation was established in 1982, offshore crude oil output was just 95,000 tons, equal to 0.09 percent of China's total crude oil output at the time. In 1990, offshore crude oil output reached 1.432 million tons, 14 times more than in 1982 and equal to 1 percent of China's total crude oil output. In 1991 offshore crude oil output was 2.41 million tons, equal to 1.7 percent of China's total crude oil output.

By the end of 1991, China had placed six offshore oil fields with a production capacity of more than 3 million tons/year into production: Chengbei, Bozhong 28-1, and Bozhong 34-2/4 in the Bohai Sea, Wei 10-3 in Beibu Gulf in the South China Sea, and Huizhou 21-1 and Huizhou 26-1 south of the mouth of the Pearl River. Moreover, development and construction are now in progress on four other oil and gas fields and feasibility research and preparatory work are being done on seven oil and gas fields. All of these oil and gas fields will go into development and construction in succession during the Eighth 5-Year Plan.

Based on arrangements for a 6 percent growth rate in China's value of agricultural and industrial output, demand for petroleum in China will reach 170 million tons in 1995 and 200 million tons in 2000. To deal with a situation in recent years of growing difficulty in exploration on the mainland and substantial reductions each year in the rate of growth in crude oil output, the state has formulated the strategic principle of "stabilizing east China, developing west China" and, while ensuring stable production at Daqing, Shengli, Liaohe, and other old oil fields in eastern China, it is accelerating exploration and development of oil and gas resources in the western China region centered on Tarim Basin. China has a vast realm for offshore exploration. Moreover, our coastal provinces and cities are economically developed and transportation by sea route is relatively convenient, so accelerating development of our offshore petroleum and natural gas industry will play an important strategic role in guaranteeing future energy resource supplies for our national economy. Based on plans in the Eighth 5-Year Plan, offshore petroleum output will reach 5 million tons and natural gas output will reach 500 million cubic meters in 1995, equal to 3.4 percent of China's planned petroleum output and 2.9 percent of planned natural gas output. Our crude oil production capacity will reach 8 million tons/year and our natural gas production capacity will reach 3.75 billion cubic meters/year. We are striving to attain a crude oil output of 7 to 10 million tons and natural gas output of 5 to 7 billion cubic meters by the end of this century.

To achieve these planned objectives, we must focus implementation of the following principles in actual work:

I. Integrate Cooperation With Foreign Countries and Our Own Exploration and Development To Impel and Develop

Offshore petroleum exploration and development involve great risks, high technical requirements, and large capital inputs, whereas China is relatively poor in capital and has weak technology, so we must adhere to the policy of cooperating with foreign countries for a long period. We have already accumulated valuable experience in cooperation with foreign countries and we

have established broad contacts and gained an excellent reputation in international petroleum circles. In the future we must make full use of these favorable conditions and adopt more flexible work methods based on actual changes in conditions to promote more effective development of cooperation with foreign countries in offshore petroleum.

Combining the implementation of cooperation with foreign countries with developing our own exploration and development will help take advantage of the forces in China's exploration and development staffs and can use real tempering to improve personnel quality and lay a good foundation for developing broader international cooperation. During the process of developing our own exploration and development, we must be concerned with fully motivating the initiative of relevant departments in the central government and provincial and municipal governments along the coast and obtain their support and cooperation in all areas including capital, materials, technology, and so on.

II. Combine Exploration for Reserve Resources With Oil and Gas Field Development

Increases in oil field crude oil and natural gas output during the Eighth 5-Year Plan will depend mainly on oil and gas fields that have already been placed into development and construction. If we provide the capital and do solid work, the objectives we have set are entirely capable of being achieved. However, offshore oil fields are characterized by a large development intensity and rapid reductions in output. To achieve our goals of struggle for the year 2000, besides speeding up development and construction of previously discovered offshore oil and gas fields, we must also be extremely concerned about exploring for reserve resources to discover new oil and gas fields quickly and ensure that reserves are replaced. For the past several years, international oil prices have been rather low and petroleum companies in foreign countries have reduced their investments of capital in offshore exploration in China. Thus, we propose that the state allocate a specific amount of capital each year from financial budgetary estimates for use in doing our own offshore exploration. If this is difficult, we can also consider having the state issue risk preferential loans and implement repayment of loans and interest from income from oil and gas sales for those which make exploration achievements. For those which do not make exploration achievements, the loans can be canceled by state financial administrations.

III. Combine Petroleum and Natural Gas Exploration and Development

In foreign countries in 1990, petroleum output was 2.98 billion tons and natural gas output was 21 trillion cubic meters. Calculated on the basis of equivalents, the ratio between oil and gas output in foreign countries was 1.4:1. In China, however, natural gas exploration and development is relatively weak and total output in China in 1990 was only 15.2 billion cubic meters. Our ratio between oil and gas output was 9:1, which is a huge disparity. In foreign countries in 1990, offshore petroleum output was 757 million tons and offshore natural gas output was 347.24 billion cubic meters, for an oil and gas output ratio of 2.2:1. In China, however, our offshore natural gas output to date is still zero. Natural gas is a clean and convenient energy resource and an important material in the chemical industry. In foreign countries, natural gas accounts for more than 20 percent of the energy resource consumption structure, 36 percent in the former Soviet Union and 23.4 percent in the United States, but just 2.1 percent in China. China's marine areas have abundant natural gas reserves. In particular, the Yingqiong Basin in the western part of the South China Sea has the geological conditions for the formation of a large gas province. Accelerating natural gas exploration in this region has major importance for changing China's energy resource consumption structure and alleviating energy shortages in the provinces of south China.

IV. Implement Integrated Upstream and Downstream Management

Development practice in the international petroleum industry confirms that petroleum companies must have integrated upstream and downstream management before they can strengthen their risk capabilities. Although international oil prices are relatively low at present, profits in several big petroleum companies have not fallen as a result. The main reason is an increase in value of output in the petrochemical and other downstream industries. In China, however, the actual situation is that: because the China National Offshore Oil Corporation and China Petroleum and Natural Gas Corporation each manage offshore and continental petroleum and natural gas exploration and development activities separately, the China Petroleum and Natural Gas Corporation is responsible for petroleum refining and the petrochemical and other downstream industries. While in theory the state begins by taking into consideration overall interests to coordinate the relationship between upstream and downstream production enterprises, the result in actual operation is often that reflections of changing conditions are slow and responses are late. Now, upstream industrial departments are facing serious capital shortages and a loss of balance in the proportion between reserves and extraction while downstream industrial departments have severe shortages of raw materials and idle processing capacity. During the process of accelerating the development of China's offshore petroleum and natural gas industry, we must borrow from the important experiences of international petroleum companies in integrated management and use importing from abroad and cooperation with units in the interior to bridge the past "fault" between the upstream and downstream aspects of the petroleum industry, turn these two industrial departments into an integral whole of mutual support and complementation, and make greater contributions to modernization and construction of the motherland.

Update on China's 'Oil and Gas Region Tertiary Research'

936B0023B Beijing JINGJI RIBAO [ECONOMIC DAILY] in Chinese 31 Oct 92 p 1

[Article by reporter Wang Ruozhu [3769 5387 4554]: "China's Research on Geological Exploration for Oil Is At Advanced World Levels"]

[Text] "Research on the Tertiary System in Oil and Gas Regions of China", a basic scientific research project with major importance for China's petroleum industry, passed inspection of its achievements by the relevant experts from throughout China on 30 October 1992.

The Tertiary system is a stratigraphic category in geology. A very large part of China's continental and marine petroleum and natural gas was generated in this geological stratum. Thus, clarifying the distributional regularities of this geological stratum in China is extremely important for future oil and gas exploration and development in China. In the past, such research was carried out independently at each oil field. Later, after the China Petroleum and Natural Gas Corporation included it in projects to attack key problems during the Seventh 5-Year Plan, 25 units and over 150 S&T personnel in China's petroleum and marine petroleum systems as well as a large number of forces from China's institutions of higher education and scientific research units were organized. They spent 5 years conducting a large amount of systematic research on China's 246 Tertiary system sedimentary basins and over 500,000 paleontological fossils and ultimately revealed the distributional regularities of the Tertiary system in China's oil and gas regions.

According to information provided by the relevant responsible person Shi Baoheng [4258 1405 3801], oil and gas resource reserves in the Tertiary system account for 45 percent of China's total oil and gas reserves. Scientific projections indicate that only 15 percent of the reserves in the Tertiary system have been extracted to date, so there are still large amounts of oil and gas resources that have not yet been explored and located. After studying China's 246 Tertiary system basins, the Tertiary system topic group feels that about 30 of the basins located throughout China have exploration and extraction value. Prospecting in these basins may lead to the discovery of relatively large oil and gas fields. For this reason, the Inspection Committee under the direction of Academic Department member and Chinese geology professor Hao Yichun [6787 6095 4783] feels that the research achievements on the Tertiary system are at "advanced international levels" and that they have "closely integrated research work as a whole with exploration and production in all oil and gas regions, provided a solid geological foundation for effectively undertaking oil and gas exploration research, and provided a timely direction for oil and gas exploration".

Oil and Gas Production: Stabilization in the East, Development in the West

936B0017C Beijing GUANGMING RIBAO in Chinese 1 Oct 92 p 1

[Article by reporter Liu Sa [0491 7366]]

[Text] This year many oil fields, despite facing torrential rains and other natural disasters, exceeded their oil and natural gas production quotas month by month, began molding a pattern of stabilization in the east and development in the west, and achieved new heights in production of oil and gas.

Oil fields in the east have plunged into production of high-water and very-high-water oil, and widely applied the experience gained at Daqing oil field in controlling water for stability of oil output with illustrious results; at Daqing, the percentage of water oil increased by only .4 points, and for the country as a whole, the comprehensive increase in water oil was only .69 percentage points, pointing the way for a line of old oil fields to stabilize their output. In the west, especially in the three large basins of Xinjiang, construction of the Xiazijie, Lunnan, Shanshan oil fields is done, and annual output capability is up to 2.5 million tons, and adding to that the Karamay oil field, etc., this year's output from Xinjiang's basins could be nearly 9 million tons, an increase of 1 million tons over last year.

This year from January to September, the national accumulative total for crude oil output was 103.61 million tons, and natural gas was 11.3 billion cubic meters, and it is estimated by year's end crude oil and natural gas will exceed quotas in completing the national plan.

Accelerating Oil Exploration in Tarim Basin

936B0013A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 22 Sep 92 p 4

[Article by Bayangol Mongol Autonomous Prefecture People's Government Office To Support Oil Field Construction: "Implement the 'Two News and Two Highs' Management System To Accelerate Petroleum Exploration and Development in Tarim"]

[Text] Achievements made in petroleum geological exploration indicate that there are projected long-term petroleum resources of 10.1 billion tons within a scope of 560,000 square kilometers in Tarim Basin, equal to about one-seventh of China's total long-term petroleum resources. It also has projected natural gas resources of more than 8 trillion cubic meters, equal to about one-fourth of China's total natural gas resources. To maintain stable growth of China's petroleum industry, the "People's Republic of China National Economic and Social Development 10-Year Program and Eighth 5-Year Plan Outline" established the strategic principle for development of our petroleum industry: "stabilize eastern (regions), develop western (regions)". It makes

clear the requirement to concentrate forces to reinforce oil and gas resource exploration and development in western China focused on Tarim and actively create transportation conditions and strive to increase output. For this purpose, the State Council established a Coordination and Leadership Group with participation by the relevant responsible persons in the State Planning Commission, Ministry of Energy Resources, and Ministry of Railways to prepare a unified program for exploration and development of Tarim oil field. The China Petroleum and Natural Gas Corporation established the Tarim Petroleum Exploration and Development Headquarters (abbreviated below as the Tarim Headquarters) at Korla City, the seat of government for Bayangol Mongol Autonomous Prefecture and decided to adopt new techniques and technologies and a new management system to fight a major high-level and high-benefit petroleum exploration and development war.

Since the war began in 1989, the Tarim Headquarters has used the "two news and two highs" requirement established by the China Petroleum and Natural Gas Corporation for actively importing "oil company" organizational and management methods in common use internationally to integrate with China's political and economic advantages and gradually form a set of new management systems centered on management by objectives and an A-B contract system that uses unified quota posted prices for comprehensive implementation of specialized and socialized services. In its actual work, it has explored and summarized a set of "two divisions and two integrations" work methods with Chinese characteristics that embody the new type of relationship between parties A and B under socialism that have revealed powerful vitality and superiority in many areas and produced significant economic and social benefits. Expenditures used directly for exploration and development and for production and construction account for about 95 percent of total investments. Relying on specialized and socialized services, Tarim Headquarters has used an investment of more than 900 million yuan to form 2.2 billion yuan in integrated exploration, development, and production capabilities that have accelerated the pace of petroleum exploration and development. The new management system has spurred the widespread application of new technologies and new techniques. The exploration region has now been outfitted with six sets of new techniques and technologies adapted to surface and underground characteristics that have raised levels in exploration and development and all aspects of work, especially in the drilling of deep wells, which now occupies a vanguard status in China and has approached world levels. The new system has very strong stimulation mechanisms and competition mechanisms that have formed a lively situation of courageous and energetic attempts to be the first that have continually improved work efficiency and overall benefits in exploration and development. Statistics show that average overall well drilling costs in the exploration region dropped by 34.7 percent between 1988 and 1989, by 26.7 percent between 1989 and 1990, and by another 5.5 percent between 1990 and 1991.

The facts have proven the feasibility of relying on laws and contracts to manage petroleum exploration projects. Although petroleum exploration labor, technology, and other markets have not yet formed in China and we have no previous experience that we can copy, this new model has revealed its gratifying advantages and it will inevitably have a broad and profound impact on intensive reform in the petroleum industry as a whole and play an effective role in promoting a transition in the petroleum industry from a product economy to a commodity economy and open up a new route for reform of the petroleum exploratory drilling system on the Chinese continent.

On the basis of work done over several years, petroleum exploration and development in Tarim has conscientiously implemented the exploration deployments decided upon by the China Petroleum and Natural Gas Corporation. It has already proven five integral oil fields—Lunnan, Donghetang, Sangtam, Jirak, and Jiefangqu Dong [Liberation Canal East]. It has also drilled several high-output oil and gas wells in the Yingmaili, Tazhong [central Tarim], and other regions. Crude oil daily output levels have now reached more than 2,100 tons and it produced 550,000 tons in 1991, a net increase of 400,000 tons over 1990. The establishment of geological reserves with a 5 million ton production capacity has now basically been implemented and the vision of an even larger area of development has been seen, contributing to stable and increased crude oil production in China. This series of facts shows that petroleum exploration and development in Tarim Basin has already achieved significant progress.

Strategies of Oil and Gas Exploration in Tarim Basin Outlined

936B0016A Beijing ZHONGGUO DIZHI [CHINA GEOLOGY] in Chinese No 9, 13 Sep 92 pp 20-23

[Article by Guo Renbing [6753 0088 3521] of the Ministry of Geology and Mineral Resources Northwest China Petroleum Geology Bureau: "The Current Situation for Oil and Gas Surveying and Development in Tarim Basin and Ideas on Development Countermeasures"]

[Text] In September 1984, the 1st Survey Brigade of the Ministry of Geology and Mineral Resources Northwest China Petroleum Geology Bureau made an important oil and gas breakthrough at the Shacan-2 well on the Yakela structure in northern Tarim. This was another important achievement by geology and mineral resources departments. Subsequently, the Ministry of Geology and Mineral Resources and China Petroleum and Natural Gas Corporation opened an oil and gas surveying and development battle focused on the Xayar uplift zone in northern Tarim. This brought vigorous vitality to this

barren piece of the Gobi Desert and attracted national attention. What, then, is the current situation in oil and gas surveying and development in Tarim Basin and the problems that exist, and how can we gain a grasp of oil and gas reserves on the scale of Daqing oil field? I would like to summarize and analyze briefly these questions which concern everyone from the geological and economic perspectives and provide some opinions to commemorate the 40th anniversary of the establishment of the Ministry of Geology and Mineral Resources.

I.

Tarim Basin is one of China's biggest petroliferous basins. Its projected petroleum and natural gas resource reserves account for one-seventh of China's petroleum resources and one-fourth of our natural gas resources, so its survey and development has a decisive status for the development of China's petroleum industry.

Since the breakthrough at the Shacan-2 well, a survey and development battle covering a area of more than 20,000 square kilometers in the Xayar uplift zone produced industrial oil and gas in a total of eight strata systems: the Protozeroic Sinian system, the lower Paleozoic Cambrian and Ordovician systems, the upper Paleozoic Carboniferous-Permian system, the Mesozoic Triassic, Jurassic, and Cretaceous systems, and the Cenozoic lower Tertiary system. Over 10 oil and gas fields have now been discovered, which is an indication that the Xayar uplift zone is a primary oil and gas accumulation zone with "five eras in the same house". In addition, statistics from well strata that produced industrial oil and gas by the staff of the Ministry of Geology and Mineral Resources fighting the battle indicate that the oil and gas achievements are mainly concentrated in the Mesozoic, upper Paleozoic, and lower Paleozoic, where wells had harvest rates of 47.6 percent, 14.3 percent, and 19 percent, respectively, and logging harvest rates of 20.3 percent, 15 percent, and 7 percent, respectively. High-output strata accounted for 41.7 percent, 33.3 percent, and 75 percent, respectively, of each of the industrial oil and gas strata. Moreover, according to statistics on the results of exploratory drilling by two staffs at high points in local structures, the three eras produced oil and gas pool discovery rates of 53.3 percent, 33.3 percent, and 26.7 percent, respectively. This shows that:

1. Mesozoic oil and gas pools occupy a prominent status and Mesozoic oil and gas-producing strata are still mainly porous thick sandstone strata with relatively stable lithologies and rather good material properties. Thus, they have conditions conducive to the formation of high-output large oil and gas fields. Moreover, the oil and gas are mainly controlled by laminar structures with easily determined regularities and are also easily discovered. In fact, the Yakela oil and gas field discovered at the Shacan-2 well is an oil and gas field formed mainly by oil and gas strata in thick Mesozoic sandstone strata. However, most of the Mesozoic structures discovered so far are gentle low- amplitude structures whose degree of closure is often smaller than the thickness of the Mesozoic, especially the thick Triassic system sandstone strata, and they have a degree of oil and gas filling of only 12 to 30 percent, with some less than 5 percent. Thus, there is still an acute contradiction between the small structural amplitudes and the great thickness of sandstone in the oil and gas geology conditions of the Mesozoic, especially the Triassic system, and this is the primary factor that greatly restricts the scale and reserves of their oil and gas pools.

2. Lower Paleozoic strata easily produce high outputs and the scope and amplitude of their structural (including unconformable surfaces with top eras) traps are both relatively large, so they do have several of the conditions that are favorable to the formation of high-output large oil and gas fields. However, producing strata in the lower Paleozoic are dominated by carbonate rock with cracks and pores, so they are non-laminar irregular reservoiring bodies with reservoiring properties that are sometimes good and sometimes bad. The regularities of crack and pore development are often less than consistent with the regularities of structural development and their regularities are hard to determine, so positions conducive to the accumulation of oil and gas are hard to discover. With the exception of Yakela, which has a substantial scale, the lower Paleozoic oil and gas pools that have been discovered so far are restricted to single wells and the single wells have a relatively rapid reduction in output, with some even displaying instantaneous deaths. Thus, the carbonate rock reservoir bodies have unstable properties and are inconsistent with structural regularities, which is still an acute problem facing the lower Paleozoic realm and the key that will affect the results of searching for oil and gas in this realm.

3. In the upper Paleozoic, where widespread indications of oil and gas have been seen, most of the oil and gas-bearing strata are thin strata of sandstone in which the harvest rate from well drilling and logging is rather low and where high outputs are not easily obtained. The Sha-18 well in the eastern part of the Xayar uplift zone set the highest output record but the oil and gas was still produced from Carboniferous system limestone cracks, the scale of the oil and gas pools was rather small, and pressure and output reductions were relatively rapid. The Donghe-1 well in the western part of this uplift zone produced daily outputs of several 100 cubic meters of crude oil from Carboniferous sandstone oil strata with continuous thicknesses in excess of 100 meters, but the thick strata of sandstone are distributed mainly in the southern part. Thus, sandstone reservoir strata are distributed rather widely but their thickness varies a great deal and their material properties are poor. The reservoir bodies have great thickness and good material properties, but a limited scope of distribution, which is still the primary problem that exists in the geological conditions of the oil and gas in the upper Paleozoic, especially in the Carboniferous-Permian system.

In summary, these problems objectively increase the difficulty of finding additional high-output large oil and gas fields in the Xayar uplift zone.

II.

During the past 3 years, oil and gas development work in northern Tarim has surged forward but because of insufficient capital for oil and gas survey work, it is becoming less and less adapted to the development requirements of the former. Statistics show that, calculated at constant prices, there was a reduction of 17.5 percent in geological survey expenditures at the end of the Seventh 5-Year Plan compared to the end of the Sixth 5-Year Plan, and present yearly expenditures are less than 5 percent of annual oil and gas development expenditures and their per capita monetary work amount is now less than 20 percent of the latter.

Because of insufficient inputs of geological survey expenditures, there has been a reduction of about 15 percent in the total number of employees engaged in the oil and gas survey battle, reductions of one-third in drilling staffs and one-fifth in seismic staffs, and reductions of 8.8 percent in the annual amount of exploratory drilling work and 15 percent in the amount of seismic work.

Moreover, insufficient expenditures on geological surveys have resulted in less-than-full oil and gas survey tasks and substantial production capacity stands idle. Over 10 percent of the equipment in the Northwest China Petroleum Geology Bureau is idle. In a situation in which one-fifth of the staff involved in the seismic survey battle has dispersed to other areas, there are still over 60 percent of the seismic teams that are in a semi-full state of "production for 4 months, idle for 8 months". In the area of exploratory drilling, work could not begin at two wells because of a failure to provide the capital. Some have already begun construction and are maintaining production despite money shortages and some wells have already been completed but have no money to settle their accounts and are forced to take out bank loans to deal with their emergencies. This never happened in the past.

Second, because of the rather substantial shortage of capital construction investments, oil and gas survey equipment is incomplete, the equipment is outdated and aged, and there are severely inadequate development reserve strengths. Statistics indicate that since 1985, there has been a 59.4 percent reduction in capital construction investments in the petroleum bureau system and a 59.8 percent reduction in that portion that is used to purchase and import equipment. Added to the upward adjustment in the parity prices of foreign exchange and continual increases in equipment prices, there has been an even greater weakening of actual abilities to make outlays to import equipment. Restricted by this macro factor, there is no ability to replace oil and gas survey equipment in northern Tarim and its newness coefficient is now less than 40 percent. The newness coefficient for digital seismographs is even lower, 30 percent of large drilling rigs are being used beyond their service lives, the completeness rate of well consolidation equipment is less than 63 percent, and the completeness rate of large hoisting and hauling equipment is less than 54 percent. In another area, because exploratory drilling lacks the equipment required for production during the winter, they must stop work and go on vacation as soon as winter arrives, so the actual production time during a year is only about 8 months. Because of the shortage of seismic equipment adapted to desert operations, seismic work in several desert zones with relatively good oil and gas geology conditions has been unable to move forward for a long time, which has affected expansion in the scope of surveying and delayed the time that oil and gas breakthroughs can be made in these zones.

It should be pointed out that oil and gas surveying and development both involved directive-type planned tasks, but development of the former is not adapted to the development of the latter, mainly because a neglect of balancing during the planned allocation of the factors of production has resulted in a loss of proportion between the two. At the same time, such a lack of adaptation is also related to the administrative and management system of departmental separation because under such a system the factors of production cannot circulate between the two departments. As a result, when there is a clear indication that the pace of oil and gas development requires major efforts to strengthen oil and gas surveying, capital still cannot be transferred as appropriate from the former to the latter. Even more troubling is that the system of departmental separation has caused the appearance of serious duplication and intersection in both oil and gas surveying and development. First, seismic work in the Xayar uplift zone formed duplication over a large area and second, the distance between intersecting wells in exploratory drilling has shrunk from 2,000 to 3,000 meters down to 1,000 meters and recently shrank again to 500 meters. This duplication and intersection causes waste and results in serious squeezing of oil and gas surveying, making it hard for survey evaluations to be carried out normally.

In summary, these problems subjectively restrict the initiative and speed of oil and gas survey staffs in their search for large oil and gas fields.

III.

Summarizing the things described above, it would appear that the factors that play a role in restricting oil and gas surveying and development work in Tarim Basin lie mainly in three areas: 1) The system of departmental separation is not conducive to fostering overall advantages; 2) Oil and gas surveying work is weak and faces difficulties in leading the way; 3) There is an inadequate understanding of vast new regions and several oil and gas realms. For these reasons, the following countermeasures must be adopted to accelerate the pace of oil and gas surveying in Tarim Basin and turn it into a strategic replacement region for China's petroleum industry as soon as possible.

A. Implement departmental integration, foster overall advantages

Through nearly 40 years of work practice, oil and gas survey staffs have formed the advantages of boldly opening up and advancing, being adept at storming fortifications, and being good at discovering oil and gas. Oil and gas development staffs have formed the advantages of a solid material foundation, a resolute working style, and being good at oil and gas development. In a system of departmental separation, however, these two staffs have been unable to form overall advantages. Moreover, the mutual blockade between these two staffs in northern Tarim and their counter-acting work methods have also prevented each of them from fully fostering their own advantages. In August 1990, leading comrades from the central authorities pointed out clearly during their inspection in northern Tarim that "there should be close cooperation between petroleum departments and geological and mineral resource departments" and stressed that "according to reason, we are socialist and should have greater mutual understanding and mutual trust than capitalism". Here, comrades from the leading authorities raised cooperative relationships between the two staffs to the height of the principle of fostering the superiority of our socialist system. For this reason, the two departments should move as quickly as possible for joint organization of a Tarim Basin Oil and Gas Resource Commission to unify planning and deployments and coordinate oil and gas exploration and development work in the basin and to form the two staffs into an integral body and achieve a division of labor and cooperation, mutual supplementation of advantages, and coordinated development to accelerate the pace of oil and gas exploration and development work in the basin.

B. Strengthen geological surveys, foster their vanguard role

The ability of oil and gas geological survey work to take the lead concerns both the development reserve strengths of the petroleum industry and the development future of our overall national economy. However, oil and gas geological survey work is obviously extremely weak, in northern Tarim as well as throughout China. Not only does it have the strength to take the lead, but it is also substantially backward compared to oil and gas development work. This requires working according to the spirit of the CPC Central Committee's "Proposals Regarding Formulation of the National Economic and Social Development 10-Year Program and Eighth 5-Year Plan" in "truly reinforcing geological survey work to coordinate its development with construction of the energy resources, raw materials, and other basic industries and basic facilities". For the present, to make oil and gas survey work move from backwardness to being in the vanguard as quickly as possible, we should increase capital construction investments in oil and gas surveying and total expenditures on geological surveys in China as well as increase capital construction investments in oil and gas surveying in Tarim Basin more than 2 times and more than double expenditures on geological surveys.

C. Adhere to scientific oil exploration, deal correctly with the three relationships

1. Deal correctly with relationships among different regions. At Xayar uplift zone, where work is now concentrated, while there have been extremely prominent achievements in oil and gas, there is still considerable difficulty and distance involved in grasping as quickly as possible oil and gas reserves on the scale of Daqing oil field. Moreover, the area of this uplift zone accounts for less than 4 percent of the basin's total area and oil and gas resources generated and reservoired in the same rock account for less than 4.52 percent of the oil and gas resources in the entire northern Tarim region, so even if oil and gas that has migrated from the surrounding area is included, its oil and gas resources account for less than one-fourth of the northern Tarim region as a whole. This shows that this uplift zone still has substantial oil and gas resource potential and that other structural elements besides this uplift zone in northern Tarim also have very good oil and gas prospects and that the oil and gas prospects of the basin as a whole are even more broad. Thus, in dealing with relationships among regions, we must resolutely adhere to the work principle of opening up new regions, moving forward with both new and old areas, and selecting those to move forward with first. This means actively and quickly selecting new regions to undertake geological survey work and fighting to make new discoveries and breakthroughs within a relatively short time to find one or two oil and gas accumulation zones similar to the Xayar uplift zone, and it means continuing to expand on victories in old regions and finding more oil and gas fields, as well as moving rapidly to put reserves into production to compensate for shortages from the reduction in crude oil output in east China.

2. Deal correctly with relationships among different strata positions. According to statistics from test industrial oil and gas flows from wells drilled by staffs fighting the battle in the Ministry of Geology and Mineral Resources, 62.3 percent were single strata system oil and gas producers, with the Mesozoic accounting for 55.6 percent, the lower Paleozoic for 22.2 percent, and the upper Paleozoic and the Cenozoic each for 11.1 percent. Those oil and gas producers that were in superimposed strata systems accounted for 37.7 percent, with the Mesozoic superimposed over the upper and lower Paleozoic each accounting for 40 percent and the Mesozoic superimposed over the Protozeroic accounting for 20 percent. Statistics for oil and gas pools discovered by two staffs fighting the battle indicate that those generated and reservoired in a single strata system accounted for 71.4 percent, with the Mesozoic accounting for 40 percent of them, the lower Paleozoic for 30 percent, the upper Paleozoic for 20 percent, and the Cenozoic for 10 percent. Those that were generated and reservoired in superimposed strata systems accounted for 28.6 percent,

with the Mesozoic superimposed over the upper Paleozoic accounting for 75 percent and the Mesozoic superimposed over the lower Paleozoic-Protozeroic accounting for 25 percent. The Xayar uplift zone is a single strata system in which most was generated and reservoired in the Mesozoic and a relatively low rate of superimposed generation and reservoiring. For this reason, in dealing with the relationships among strata systems, we should adhere to the guiding product of working on several strata simultaneously, differential treatment, and moving ahead first with the easy and later with the more difficult. Concretely speaking, we should try to have drilling rigs that are capable of deep exploration for the first or second wells in new structures in new regions to facilitate a comprehensive understanding and gain an overall grasp of the oil and gas geology conditions and oil and gas-bearing situation in each strata system, and use this as a basis to select the more hopeful strata systems that also produce oil and gas achievements easily as the primary targets for attack and to make the corresponding decisions regarding the depth of exploration in an effort to make breakthroughs quickly. For old structures in old regions, decisions should be made on different target strata systems and depths of exploration according to regions to enable a faster pace and reduce inputs while obtaining optimum oil and gas achievements.

3. Deal correctly with the relationships among different categories. While the geological structures in this region are gentle and simple, there are still variations in strata lithofacies, especially changes from multiple instances of structural activity that resulted in diversification of the contact relationships among Mesozoic and Paleozoic strata. There are often different combinational relationships in different regions that, in conjunction with differences in the amplitude of uplifting and subsidence and differential compaction inside the basin during the Mesozoic and especially since the Cenozoic, determined that this basin not only easily formed low- amplitude structural oil and gas pools but also that non-structural oil and gas pools may have formed on a substantial scale. Second, rather good seismic wave reflection groups can be obtained from sandstone and mudstone regions, inside carbonate rock, and each unconformable surface in this region, which has created the conditions for finding low-amplitude structural oil and gas pools and exploring for non-structural oil and gas pools. For this reason, in the area of dealing with different categories we must adhere to the technical ideology of using scientific research to open routes with conventional ones as the dominant factor while also exploring multiple routes and focusing on doing these three items of work well. First, we must make a major effort to reinforce detailed processing of seismic data and conscientiously carry out research on Mesozoic and even Cenozoic low-amplitude structures and their mineralization factors to provide a foundation for the discovery of additional Mesozoic and even Cenozoic low-amplitude structural oil and gas pools. Second, we must apply the methods of seismic stratigraphy and do intensive research on sandstone reservoir strata, especially the distributional and developmental regularities of thick sandstone bodies to open up new routes for finding lithologic and stratigraphic oil and gas pools. Third, we should import and utilize new seismic technology methods and truly reinforce exploration and research on the developmental regularities of cracks and holes in carbonate rock and their shape characteristics in an effort to open up a new situation in this realm.

In summary, if we truly reinforce oil and gas geological survey work we will make new discoveries and breakthroughs in Tarim Basin and an even larger new arena will appear.

Infusion of Technology at Liaohe Turns "Dead" Wells into "Live" Ones

936B0017A Beijing GUANGMING RIBAO in Chinese 25 Sep 92 p 2

[Article by reporter Miao Jiasheng [5379 1367 3932]]

[Text] In the realm of petroleum resources, the heavy oils and high-viscosity oils, because of the problems they present in extraction and processing, are called "dead" oil in many oil producing countries. Among the crude oils extracted at Liaohe, heavy and high-viscosity oils make up 56 percent, and extraction, collection, and shipping technology at Liaohe are on the cutting edge of the world's technology.

There are rare oil deposits in the geological structure of Liaohe, and the difficulty of extracting heavy and high-viscosity oil deposits there is serious. In order to augment oil field production and reserve volumes the Liaohe Petroleum Prospecting Bureau has looked to S&T advances for solutions to the development of heavy and high-viscosity oils. In the 1980s they organized a series of key research approaches on the various aspects of geological research, drilling, extraction, and oil and gas collection and shipping, and made many advances in S&T, over 90 percent of which have been put to use, including accoutrements for heavy oil pumping technology, steam flushing extraction technology, and in the basic accessories for extraction of high-viscosity oils, which have given a great boost to the crude oil output figure for the Seventh 5-Year Plan. In 1982, Liaohe oil field produced only 5.34 million tons of crude oil; by 1991 this had increased 1.56 times, to 13.7 million tons, of which heavy and high viscosity oils had increased by about 90 percent.

In order to spur S&T advances, the Liaohe Petroleum Prospecting Bureau, each year, used a large portion of production and capital construction funds for scientific research, development of technology, and dissemination of new technology. Since 1986, more than 20 million yuan were devoted every year to S&T expenses, and this year it will exceed 30 million yuan. In addition, a fairly large outlay of funds goes into technology reform, on-site

scientific tests, and advanced oil field tests. In 1991 and this year alone, advanced testing expenditures were 30 million yuan and up.

More Results From Prospecting in Xinjiang's Three Basins

936B0016B Beijing JINGJI RIBAO [ECONOMIC DAILY] in Chinese 1 Oct 92 p 1

[Article by reporter Xie Ranhao [6200 3544 3185]: "Petroleum Exploration in Xinjiang's Three Large Basins Produces New Achievements, Gratifying Exploration Situations in Shaan-Gan-Ning and Sichuan Gas Basins"]

[Text] Information provided on 30 September 1992 by the China Petroleum and Natural Gas Corporation indicates that during 1992, reinforced exploration work produced several new achievements in Xinjiang's three big Tarim, Turpan-Hami, and Junggar Basins. Projected petroleum output in these three big basins for all of 1992 may reach 8.74 million tons, an increase of 970,000 tons over 1991.

Besides the several new reserves obtained at Jirak, Jiefang Qu [Liberation Canal] East, Sangtam, Lunnan, and other oil fields in Tarim Basin, a large favorable region for development covering a total area of 836 square kilometers was located in the Tazhong [central Tarim] region.

Good oil and gas indications were seen in both the No 3 and No 4 exploratory wells drilled in the premontane zone. Oil and gas strata 136 meters thick were discovered in the Hongtai structure and the Ge-1 well in the Qiktim structural zone produced an industrial gas flow with a daily output of 30,000 to 40,000 cubic meters at a depth of 500 meters.

In Junggar Basin, an advance into the desert region in the central part of the basin discovered a new region for oil exploration covering an area of 5.3 square kilometers that contains abundant oil and gas resources.

Information provided by the China Petroleum and Natural Gas Corporation indicates that abundant achievements have been made in natural gas exploration during 1992 in the Shaan-Gan-Ning [Shaanxi-Gansu-Ningxia] and Sichuan Basins.

In Shaan-Gan-Ning Basin, besides the geological reserves already proven in the central region, an area of gas-bearing reserves covering 1,420 square kilometers has also basically been proven on the southern and northern sides and it has been projected that the reserves proven by the end of 1992 may be more than double the total originally proven reserves.

In Sichuan Basin, besides the two gas fields already proven during 1992, four gas-bearing structures were discovered with proven geological reserves of more than 10 billion cubic meters.

Because of the discoveries listed above, the proven reserves that the China Petroleum and Natural Gas Corporation will turn over to higher authorities during 1992 may be four times greater than the original plan, completing the Eighth 5-Year Plan 3 years ahead of schedule.

Industrial Flow Found for First Time in Liaodong Wan

936B0013B Beijing JINGJI RIBAO [ECONOMIC DAILY] in Chinese 7 Oct 92 p 1

[Article by reporter Zhang Shirong [1728 0013 2837]: "First Industrial Oil Flow Discovered in Liaodong Bay"]

[Text] Oil strata at seven strata positions and more than 40 meters thick were discovered during mid-course logging at a well in the northern part of Liaodong Bay. They produced a daily crude oil output of 25 tons and a daily natural gas output of 50,000 cubic meters. This is a major breakthrough in exploration in shallow sea areas of the Liaohe oil field, and it has opened up broad prospects for finding new oil and gas fields in the northern part of Liaodong Bay.

The shallow sea region of Liaodong Bay has a total of 3,412 square kilometers in exploration area and six of eight pre-exploration wells that have been completed so far produced oil and gas indications.

Chinese Petroleum Delegation Visits Four European Countries

936B0014B Beijing RENMIN RIBAO in Chinese 24 Sep 92 p 1

[Text] Wang Tao, President of the China National Petroleum And Natural Gas Corporation, by invitation from the U.K., Italy, the Netherlands, and Germany, lead a 10-member delegation which departed for London on 23 August to visit the above mentioned countries. The Chinese petroleum delegation will meet separately with leaders of the four West European governments and world petroleum industry leaders for discussions on broadening international cooperation in petroleum endeavors on the China mainland, and also to buy advanced technology, facilities, and special pipe materials. This is the first time a Chinese petroleum delegation of this composition has made such a visit to Western Europe in recent years. In the spirit of the important talks made during Deng Xiaoping's first southern tour, and foreign policy set down by the Chinese government, the China Petroleum and Natural Gas Corporation has decided that while continuing the difficult prospecting and cooperative development in the 11 southern provinces, a variety of active means will be adopted to obtain more foreign funds, technology, and management experience, and to broaden cooperation with foreign corporations on the east coast, in the shallow seas, and at several selected locations in the northwest, in order to accelerate the development of China's petroleum industry.

On China's Nuclear Power Development Strategy

936B0026B Beijing ZHONGGUO NENGYUAN [ENERGY OF CHINA] in Chinese No 10, 25 Oct 92 pp 3-5

[Article by ZHONGGUO NENGYUAN reporter Tian Li [3944 0500] of the China Nuclear Industry Economics Institute: "Seize the Opportunity, Develop Nuclear Power—Rethinking China's Nuclear Power Development Technical Line"]

[Text] After going through a "struggle between neglect and concern and a struggle between large and small" lasting more than 10 years, nuclear power has established the technical line of developing mainly 600MW pressurized-water reactors [PWR] in the short term and proposed the technical principle of "shifting to domestic production, standardization, systemization". As a result, the concept that "standardization means one standard for 600MW PWR, systemization means one system for 600MW PWR" has formed in the minds of many comrades.

In fact, while establishing the technical line mentioned above, China has begun technical cooperation with France and has imported and built the Daya Bay PWR power plant with two 900MW units. So far, Daya Bay Nuclear Power Plant is nearing completion and it is possible that we may built a third and fourth 900MW nuclear power plant. The 300MW-grade first phase Qinshan Nuclear Power Plant has now been connected to the grid and is generating electricity and preparatory work for construction of a 300MW unit for the second phase at Qinshan is now being actively considered. Moreover, 300MW PWR nuclear power plants have substantial attraction for several Third World countries that have not yet developed nuclear power. However, progress has been slow in our attempt to achieve a "standardized and systematized" 600MW PWR nuclear power plant and there are many problems. Besides the technical difficulty, the main reason for this is that the state's failure to provide the capital has affect capital investments by localities and departments. To get out of this situation and to take advantage of favorable opportunities in the next 10 years to accelerate the development of nuclear power, we must have a new understanding of the technical lines, principles, policies, and so on for developing nuclear power.

China is a big country with a vast territory and there are major differences in the industrial foundations, power grid grades, and geological, geographic, and environmental conditions of each region. For this reason, it is impossible to attempt to use a single power grade power plant to satisfy the needs of different grids, so there objectively exist requirements for different power grade power plants. This point cannot be denied by anyone. On the other hand, taking into consideration technical policies, China has never proposed a "single standard and single series" for any type of large industrial product, so why are we placing this type of "inhibition" on our development of nuclear power?

Some comrades might say that what we are speaking of is the starting phase and that we should concentrate our forces to develop one type of reactor and one power scale. In fact, however, China's first nuclear power to generate electricity is the 300MW-grade first phase Qinshan Nuclear Power Plant and we are preparing to complete the 900MW-grade Daya Bay Nuclear Power Plant, so why can't we continue to summarize and perfect experience from the first phase at Qinshan as a foundation for using China's own manufacturing capabilities and continue to build several 300MW-grade nuclear power plants and put them on the international market? Why can't we continue developing several 900MW-grade nuclear power plants? Isn't "selling first and studying later" something that has never been done in China's other industrial departments in the past or confirmed as a successful development path?

When talking about "shifting to domestic production, standardization, and systemization", many comrades like to use France as an example and talk about France's experience, and use this as a basis for saying that China should expend all its efforts on developing a series of 600MW PWR like the second phase at Qinshan. However, objective analysis of France's experience in developing nuclear power shows us that France developed nuclear power one step at a time. It built seven, eight, or more than 10 nuclear power plants at each stage (that is, each series). Thus, if we are talking about France's experience, we will draw this conclusion: if we wish to achieve standardization and systemization on the basis of a shift to domestic production, then China should now use the material foundation and design and construction staffs formed during the first phase at Qinshan and continue working on seven or eight or at least four or five 300MW units and use them on a foundation of continual improvement and perfection to form systematic and integral commercial nuclear power technology with Chinese characteristics and use this as a basis for making a transition to the 600MW grade. In this way, the design of 600MW units can truly absorb experience from the 300MW units. Otherwise, the 300MW and 600MW units will be completely detached, which will waste manpower and materials but even more importantly we will lose an opportunity to develop nuclear power and delay the development of nuclear power overall.

Based on present progress with the AP600, it can be expected that after we build several additional 300MW nuclear power plants, the AP600 technology will be mature and we will have the complete conditions for leaping directly up to the AP600 stage and skip over the conventional 600MW stage. In reality, if the 600MW series continues to progress at its present pace, it is entirely possible that we will face this sort of choice in the end: conventional 600MW PWR technology that still awaits perfection or AP600, which is already mature. Should we continue working on conventional 600MW units? Should we abandon conventional 600MW units

and leap directly to AP600? Or should we work on both of them? I feel that to gain the initiative and reduce losses, an early choice is better than a late choice and abandoning it later is not like shifting tracks earlier.

Several programs exist in reality for China's nuclear power development. Program 1 is to continue building 300MW nuclear power plants. The plant can be sited at Qinshan for batch orders and batch production. Taking into consideration the fact that we already have a substantial foundation for preparatory work at Qinshan and that many of the facilities can be used jointly, the manufacturing schedule can be selected as 6 years to place one generator into operation each year from 1992 to 1995, so we could place 1,200MW of nuclear power generators into operation by the year 2001. In this way, 300MW nuclear power technology could attain more technically mature and more economically competitive commercial use. Guangdong could continue importing two 900MW nuclear power generators from France and select a construction schedule of 8 years, starting construction in 1993, pouring the first vat of concrete in 1995, and placing the first generator into operation in 2001. The second generator would go into operation in 2002. By 2002, our total installed generating nuclear power capacity could reach 5,100MW. Including one 300MW unit exported to Pakistan, the total nuclear power installed generating capacity could reach 5,400MW. If we start manufacturing our first AP600 unit in 1996 and place it into operation in 2002, our total installed generating capacity could reach 6,000MW, and we would achieve the low program objective for our medium and long-term nuclear power plan. This would also bring vitality to the nuclear fuel circulation industry system that presents China with so many problems.

Program 2 is to work on two additional 300MW nuclear power generators (including one unit exported to Pakistan) and then stop developing 300MW units and continue with two 600MW units at Qinshan. With trouble-free conditions, they could all go into operation in 2002 and progress in the second phase at Guangdong's nuclear power plant would be the same as in Program 1. In this way, our total nuclear power installed generating capacity in the year 2002 could reach 5,700MW (including one 300MW unit exported to Pakistan). In this program, however, because the 600MW series for the second phase at Qinshan is the first one, there would be substantial risks involved for the technology and capital and it is possible that the progress would be delayed and this 1,200MW could fall through. Thus, it would be more practical to attain a nuclear power installed generating capacity of 4,500MW. By doing this, the 300MW technology would reach a deadlock and the 600MW technology would also be immature.

Program 3 is affected by the superficial understanding of "standardization and systemization" and "preference for developing the two 600MW units in the second phase at Qinshan" to stop the second phase at Qinshan or slow down its development and only develop one 300MW to assist Pakistan and delay the establishment of the second phase project at Guangdong. This would mean attaining an installed nuclear power generating capacity of just 3,600MW by the year 2002. Deducting the one 300MW unit exported to Pakistan, this would be only 3,300MW. At that time, as the peak of investments in the Three Gorges project arrives, nuclear power would use its favorable development opportunity and it would be hard to move quickly even if we wanted to.

In summary, it is quite apparent that Program 1 is the best plan, Program 2 is the middle plan, and Program 3 is the worst plan. If there are no breakthrough changes in China's guiding ideology for nuclear power development, Program 3, which is the least desirable program, will become the one most likely to happen.

To achieve Program 1, I offer the following policy proposals for the relevant departments:

1. For the State Council's Nuclear Power Leadership Group and State Planning Commission, there are two objectives in developing nuclear power. One is to try for the largest possible installed nuclear power generating capacity and satisfy the growing demand for electric power from development of our national economy. The second is to use development of nuclear power technology to spur reinforcement of overall levels and strengths in the relevant industrial departments. For this reason, we should adopt the principle of "walking on two legs". On the one hand, support regions with solid economic foundations and rapid growth in electric power in using imported high power-grade nuclear power generators to meet their demand for electricity as quickly as possible while at the same time guiding and organizing all relevant industrial departments to absorb and digest the imported technology and make a gradual transition to domestic production. On the other hand, in accordance with the principle of "realistic, feasible, and highly effective", support nuclear industry departments in developing, designing, and manufacturing large and medium-scale generators that involve less difficulty in shifting to domestic production and gradually make them mature and perfect. Concretely speaking, we should move quickly to establish the project and get started on the second phase nuclear power project at Guangdong and at the same time support preparatory work for the second phase at Qinshan and establish the project after the conditions are mature. For the second phase at Qinshan, there should be renewed benefit/cost discussions based on international trends in nuclear power development and the actual progress situation at this project, and we should analyze whether or not it would be more reasonable to transfer the money originally planned for the second phase at Qinshan for use in developing the 300MW series units and make a decision soon.

2. For the Ministry of Energy Resources, we must consider meeting the need to increase our installed electric power generating capacity in the short term and

consider the comprehensive balance of power generation, transportation capacity, and environmental protection and the rationality of the energy resource structure that is required to guarantee long-term energy resource supplies. For this reason, when considering long-term energy resource plans for all of China, there must be specialized research on regional plans for developing nuclear power and adoption of different guiding principles for nuclear power development for different regions by integrating with actual situations. We should make a major effort to support those nuclear power projects that are realistic and feasible and that can satisfy short-term requirements, and which would aid in long-term development (such as the 300MW nuclear power series and second phase nuclear power project at Guangdong).

3. For the Nuclear Industry Corporation, the most important objective in developing nuclear power is to attain the largest nuclear power installed generating capacity. For this reason, we must on the one hand hold an attitude of welcoming and support for nuclear power projects that use all types of routes to raise capital and have all forms of management models and provide active support in all areas. On the other hand, we must not stop work to prepare for construction of the small 300MW second phase project at Qinshan in order to guarantee the 600MW second phase at Qinshan. In many instances, it is common for "flowers intentionally planted not to blossom while willows inserted unintentionally will sprout". If we stop working on the small second phase project at Qinshan, it will affect the 300MW design and the stability of the manufacturing staff and pose a risk of scattering the organization. If we resolutely work on the small second phase and continue working on the small third phase and small fourth phase, the 300MW units will develop into a series of nuclear power generators with Chinese characteristics. Thus, we should not set development of 300MW unit and development of 600MW units in a position of opposition. Instead, while actively fighting for the 600MW units we must also continue developing the 300MW ones. In this way, if we can move forward with the 600MW units there will certainly be benefits. If we cannot move forward, the 300MW units will have the advantages of smaller investments, having design, manufacturing, installation, and construction experience, and a higher degree of public acceptance and become fist [leading] products that go on to open up and corner the market. Simply increasing our installed nuclear power generating capacity will bring vigor and vitality to the entire nuclear industry system and nuclear power will naturally receive the attention of the state and the favor of users.

In summary, the next 10 years is the key period for China's development of nuclear power. After a decade, all of the older generation of scientific research and technical personnel and technical workers who have participated in the first pioneering work in our nuclear industry and gained rich experience will retire from the front line. If we fail to use a large amount of real engineering projects to train and temper a staff, the "personnel dislocations" that now exist will cause a big landslide in overall levels in China's nuclear industry in the future. Moreover, the peak of investments in construction of the Three Gorges project and Xinjiang oil fields will arrive and inevitably impact state investments in nuclear power. For this reason, whether considered from the perspective of maintaining healthy and stable development of China's nuclear industry staff or from the perspective of guaranteeing the stability of China's long-term energy resource supplies, all administrative departments in China at every level must start now in adopting new measures and selecting truly feasible development lines and technical programs, seize the opportunity, and accelerate the development of nuclear power.

Work Begins on Phase Two of Qinshan Plant

936B0013C Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 27 Oct 92 p 1

[Article by reporters Tang Qingzhong [0781 1987 1813] and Zhang Jun [1728 6511]: "China Begins Building Second Phase Project at Qinshan Nuclear Power Plant, Installed Capacity of Two X 600MW Planned for Completion in 2000"]

[Text] China will begin construction of the second phase project at Qinshan Nuclear Power Plant. Preparatory work for it is now basically in order.

China has already built a 300MW pressurized-water reactor nuclear power plant at Qinshan. The site selected for the second phase project is at Yangliu Shan on the shore of Zhejiang's Hangzhou Bay. It will have an installed generating capacity of 2 X 600MW and is planned for completion and will start generating power in the year 2000. This project will be built and operated by the China Nuclear Power Qinshan Joint Management Company.

According to the information, construction of the second phase project at Qinshan was decided upon by the State Council Standing Committee in 1986 and establishment of the project received formal approval in October 1987 and it was included in the state's Eighth 5-Year Plan. In July 1991, the feasibility research report for the project was approved by the State Planning Commission.

Now, preparatory work for this project including engineering experiments, the preliminary design, and fixed-site work for much of the equipment is basically in order.

It is expected that after this power plant is completed, it can provide the east China region with about 7 billion kWh of electricity each year.

Low-Temperature Reactor Refrigeration Experiment Successful

936B0008A Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 19 Sep 92 p 1

[Article by reporters Jiang Hong [3068 4767] and Ma Xuquan [7456 2700 3123]: "Successful Refrigeration Operation of Low-Temperature Nuclear Heat- Supply Reactor, A Key State Project To Attack S&T Problems During the Eighth 5-Year Plan"]

[Text] Refrigeration operation of the low-temperature heat supply reactor, a key state project to attack S&T problems during the Eighth 5-Year Plan, was successful recently at the Qinghai University Nuclear Energy Technology Design and Research Academy. This was the first low-temperature nuclear energy refrigeration experiment carried out in China.

The research project on refrigeration using the 5MW low-temperature nuclear heat supply reactor is an important part of research on comprehensive utilization of the low-temperature nuclear heat supply reactor. With coordination by Kaifeng General Purpose Machinery Plant and the Qinghua University Software Development Center, Qinghua University's Nuclear Energy Technology Design and Research Academy began designing a refrigeration loop in 1990 and did the equipment installation in October 1991. Debugging was completed in June 1992 and they successfully carried out 72-hour refrigeration power operation.

Nuclear energy low-temperature refrigeration uses the steam generated by the 5MW low-temperature nuclear heat supply reactor and a double-effect lithium bromide absorption refrigerator to transmit cold water at 6°C to the rooms of users for air conditioning and cooling. The results of the experiment show that operation of nuclear energy low-temperature cooling is safe, reliable, and stable and that when the air temperature during the summer exceeds 30°C, the temperature in a room can be maintained at 18°C to 25°C.

Lithium bromide absorption refrigerators are an advanced refrigeration technology that is now developing very quickly internationally. They use the highly absorptive material lithium bromide to produce cold water for cooling large areas. This is the first time in China that low-temperature nuclear heat supply reactor refrigeration technology has been integrated with lithium bromide absorption refrigeration technology.

Experts in related fields feel that using the low-temperature heat supply reactor as a heat source for air conditioning and cooling of a large area can alleviate shortages of conventional energy resources and that it can improve the urban environment and is an ideal heat source for refrigeration.

The successful test of the 5MW low-temperature nuclear heat supply reactor lithium bromide absorption refrigeration system opens a new route for comprehensive utilization of the low-temperature nuclear heat supply reactor and provides a technical foundation for future designs for large commercial nuclear heat supply reactor refrigeration, construction, and operation. This achievement occupies a vanguard status internationally.

Nation's Energy Conservation Achievements Reviewed

936B0026C Beijing ZHONGGUO NENGYUAN [ENERGY OF CHINA] in Chinese No 10, 25 Oct 92 pp 32-35

[Article by Qin Shiping [4440 0013 1627] of the State Planning Commission and Chinese Academy of Sciences Energy Resource Institute: "Rethinking China's Energy Conservation Achievements and the True Meaning of 'Structural Energy Conservation'"]

[Text] The book "LIUWU" SHIQI ZHONGGUO JIEYUE NENGYUAN LUNWEN XUANJI [Selected Articles on Energy Conservation in China During the Sixth 5-Year Plan] collected 11 representative treatises regarding analysis of China's macro energy conservation. All of the articles originated from research projects on the issue of energy conservation in China during the Sixth 5-Year Plan that were directly organized and implemented by the State Planning Commission's Energy Conservation Bureau. I will first use some statements from "Selected Articles on Energy Conservation in China During the Sixth 5-Year Plan" (abbreviated below as the "Selected Articles") to provide the key arguments in my own article.

During the Sixth 5-Year Plan, we completed national income energy conservation of 149.18 million tons of standard coal and industrial energy conservation of 141.72 million tons of standard coal, over-fulfilling the task of reducing use of and conserving about 70 to 90 million tons of standard coal required in the energy conservation plan for the Sixth 5-Year Plan. ...the amount of energy resources consumed per 100 million yuan in gross value of industrial output was reduced from 78,400 tons of standard coal in 1980 to 56,900 tons of standard coal in 1990, an average yearly reduction of 6.2 percent.

In terms of the structure of the amount of energy conserved, reductions in energy use from readjustment of the industrial structure and product mix accounted for about one-half of the total amount of energy conserved, reductions in use of energy resources used increased imports of high energy-consuming products accounted for about one-sixth, and energy conserved by strengthening management and carrying out technical upgrading to conserve energy accounted for about one-third."

Readjustment of the industrial structure during the Sixth 5-Year Plan was the key to over-fulfilling energy conservation tasks. ...the value of industrial output from iron and steel, cement, chemical fertilizer, glass, ceramics, basic raw materials, and other high energy-consuming products accounted for 56.1 to 59.5 percent of the statistical value of product output and energy consumption accounted for 84.5 to 86.1 percent of total energy consumption of all statistical industrial products. Machinery, light industry and textiles, food products, sewing, consumer goods, and other low energy-consuming industrial products accounted for about 43.9 to 40.5 percent of the value of output and their energy consumption for about 15.3 to 13.9 percent. From 1980 to 1985, the statistical value of output energy conservation from low energy-consuming industries increased from 14.48 percent of industrial energy conservation in 1980 to 84.6 percent in 1985. It is apparent that "indirect reductions in energy use during the Sixth 5-Year Plan were due mainly to rapid development of the processing industry...."

These statements show these facts: the results of qualitative analysis are that structural readjustment (referring to energy, enterprise, and product structures) can conserve large amounts of energy resources. The results of quantitative analysis show that structural energy conservation during the Sixth 5-Year Plan was 80 to 100 million tons of standard coal while the amount of energy conserved by reducing consumption per unit of product was 35 million tons of standard coal. Structural readjustments have had substantial benefits for energy conservation in China. Still, whether or not reduced utilization of energy resources from structural readjustments is actually "energy conservation" is a question that deserves reconsideration. Through analysis of energy conservation work in China during the past 10 years, I feel that "structural energy conservation" basically should not be included within the scope of energy conservation and that the role of the "energy conserved through structural readjustments" should be reassessed.

First, we can examine the correct definition of energy conservation. "Energy conservation refers to reduced consumption of energy resources with the precondition of providing an equivalent amount of products or equivalent services to society". One can see that the concept of energy conservation refers to reductions in energy consumed per unit of product and not reductions in energy consumed per value of output. During the Sixth 5-Year Plan, the rate of growth for China's high energy consuming industries was far lower than that in low energy consuming industries, so there was a significant reduction in energy consumption per value of output. However, readjustment of the industry structure merely reduces the proportion of high energy consuming products among total products in society and cannot reduce unit energy consumption of high energy consuming products that continue to be produced. In other words, there has been no significant change in energy resource utilization efficiency in high energy consuming industries that continue to produce. Thus, this is not energy conservation in the true sense.

To be precise, energy conservation refers to the two main categories of activity of relying on S&T progress to reduce the consumption of energy resources per unit of product and using reinforced management to reduce energy consumption. Reductions in consumption of energy resources from structural readjustments should not be treated as energy conservation.

While doing research on the question of energy conservation in rural production departments, I encountered a special case. In aquaculture departments, structural readjustments in the breeding and fishing industries

caused changes in energy consumption. The greater the proportion of breeding, the lower the amount of energy consumed per ton of aquatic products. This would seem to be a special case of structural readjustments having reduced energy consumption per unit of product. Further analysis should that this was not the case. First of all, breeding and fishery are two industries in name, but in reality they are both part of the aquatic product production industry and they provide society with similar aquatic products. Their differences lie only in production techniques and the manner in which they obtain their products. Second, compared to fishing, breeding is a manifestation of technical progress. The process of mankind moving from directly hunting for food from nature to the taming and domestication of wild animals and plants is in itself an embodiment of technical progress and well as an indicator of human civilization. Artificial breeding of prawns, crabs, and other aquatic products was not achieved until recently and is still viewed as a high-S&T technology at present. The replacement of fishing by breeding is not the replacement of one industry by another. Instead, it is the replacement of one mode of production by a more advanced mode of production. As a result, this type of change causes a reduction in energy consumption per unit of product and should fall within the scope of technological energy conservation.

Further examination of the dynamics of structural readjustment leads to the discovery that structural readjustment is based on satisfying market demand, or it can be said that it is based on satisfying ultimate consumption in society.

During the past 10 years, there have been rather substantial readjustments of China's industrial structure as a result of the fact that 10 years ago China's industrial configuration was "too much focus on heavy industry, too little focus on light industry" and our product configuration was "too much focus on production, too little focus on consumption". The objective of the readjustment was to resolve problems in the proportions of heavy and light industry and the loss of proportion between production and consumption, and did not originate because of excessive consumption of energy resources.

To achieve coordinated development of our national economy, we must make readjustments in departments that have lost their coordination. The theoretical value of this type of readjustment is to attain the optimum state of large-scale production in society without overstocks. As a result, the inevitable consequence of readjustment is that consumption of mineral resources, energy resources, labor power, capital, time, and other factors of production tends toward the minimum amount. The reduction in energy consumption is merely one of the inevitable benefits and is not the only goal in structural readjustment.

From the perspective of using fewer energy resources, there is no doubt that the smaller the proportion of high energy consuming products, the better. However, the overall situation in large-scale production in society basically does not permit this. When high energy consuming products are compressed down to an unreasonably low level, it can affect development of the entire national economy, at which time the proportion of these products that are produced must be increased, which causes energy consumption per value of output to rise. Thus, it can be said that structural readjustment purely for the purpose of reducing energy consumption does not exist.

There may be some people who suggest Japan's industrial structure to refute this viewpoint. In truth, the proportion of high energy consuming products in Japan is relatively small, but this does not prove that the objective of structural readjustment can be to reduce energy consumption. Japan imports a large amount of its high energy consuming products, which is simply shifting off the contradiction between supply and demand for energy resources. Moreover, the cost of this method is a sacrifice of the integrity of the national economy. Because of a shortage of resources, importing large amounts of high energy consuming products has made Japan's economy dependent to an extremely great extent on resources from other countries. We can easily imagine that were Japan to be subjected to the treatment that Iraq received during the sanctions, its national economy would sink into a tragically paralyzed state.

The analysis above shows that reductions in the use of energy resources from structural readjustment cannot be viewed as energy conservation. True energy conservation should be the energy resources that are conserved from a reduction in energy consumption per unit of product. Rethinking China's energy conservation achievements based on this viewpoint, it would appear that they are not that inspiring, but nevertheless reality cannot be evaded. (Because the relevant data from the Seventh 5-Year Plan have not yet be fully made public, this article mainly uses data from the Sixth 5-Year Plan).

Although energy conservation during the Sixth 5-Year Plan did amount to 150 million tons of standard coal, this was due mainly to reliance on structural readjustment and imports of high energy consuming products, while the proportion of energy conservation from relying on technical progress was quite small. The energy conservation capacity formed from capital construction for energy conservation and technical upgrading to conserve energy was 29,282,400 tons of standard coal, which included 8,957,400 tons from capital construction projects to conserve energy and 20.325 million yuan from technical upgrading projects to conserve energy ("Selected Articles"). Taking into consideration the role of other capital construction and technical upgrading projects in reducing consumption per unit of product, the total amount of technological energy conservation should be higher than the data given above. However, based on calculations of reductions in unit consumption for 104 types of China's primary high energy consuming products, the total amount of technological energy conservation was only 30 to 35 million tons, with an additional 5 to 10 million tons of energy conserved through reliance on scientific management. It is apparent that the sum of technological energy conservation and administrative energy conservation is

only about 40 million tons of standard coal. The true average annual energy conservation rate during the Sixth 5-Year Plan was less than 2 percent.

The usual statistics include the impact of structural readjustment and imports of high energy consuming products on demand for energy resources, so the energy conservation rate can be as much as 6.2 percent, while the energy conservation rates in the developed countries during the same period were all 2 to 3 percent. Still, the developed countries have basically formed a more coordinated and stable national economic structure during the process of industrial development over a long period, so their energy conservation comes mainly from relying on technical progress and stronger management. In fact, China's industrial levels are relatively low and our energy resource utilization rates lag far behind the developed nations. This would imply that there is greater potential for energy conservation in China, but the sad thing is that China's energy conservation rates are still lower than the developed countries. In many research articles comparing energy consumption levels in China and the developed countries, when the subject of the discrepancy between them is raised, the statement that "there are many incomparable factors here" is frequently added. This so-called incomparability refers mainly to the industrial structure, product mix, enterprise structure, energy resource imports and exports, and other questions. When we are discussing energy conservation rates, then, it should be stated that in considering "incomparable factors" in computing the amounts of energy conserved, China's energy conservation rate is lower than the developed countries.

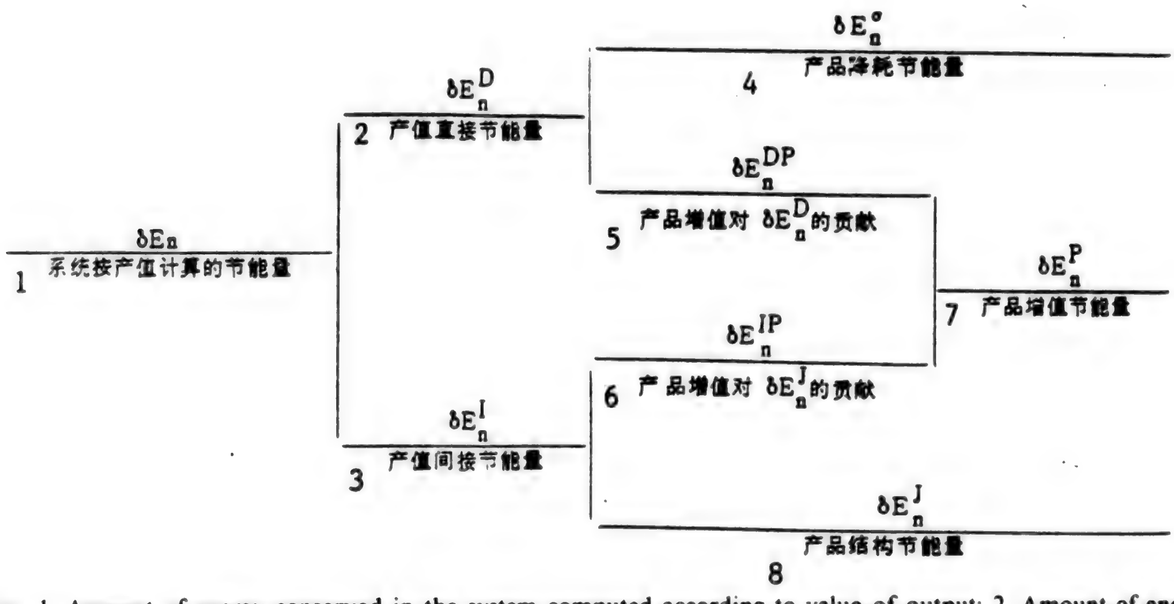
I do not mean to improperly belittle China's accomplishments in energy conservation, but seeking truth from facts in analyzing the "incomparable factors" to compute the amount of energy resources China has conserved will help to prevent blind optimism and aid further intensification of energy conservation work in the future.

I propose that "structural energy savings" be changed to "the impact of structural readjustment on amounts of energy resources consumed". Considering things from a macro perspective, it should not be included within the scope of amounts of energy conserved. However, doing quantitative research on it is both important and extremely necessary. Its primary role is to use it as an important impact factor when studying forecasts of demand for energy resources. In this area, the newest research achievements in the article "Some Macro Indicators of Economic Growth and Energy Conservation" by comrades Wang Shumao [3769 2885 5399] and Zhou Fengqi [0719 7685 6386] (ZHONGGUO NENGYUAN, No 4, 1992) divide the structure of amounts of energy conserved into the following formula:

$$\begin{aligned}\delta E_n &= \delta E_n^D + \delta E_n^I \\ &= \delta E_n^\sigma + \delta E_n^J + (\delta E_n^{DP} + \delta E_n^{IP}) \\ &= \delta E_n^\sigma + \delta E_n^J + \delta E_n^P \qquad \cdots\cdots(53)\end{aligned}$$

$$\text{whereas} \quad \delta E_n^P = \delta E_n^{DP} + \delta E_n^{IP} \quad \cdots\cdots(54)$$

The meaning of each item in the formula is shown in the diagram below.



Key: 1. Amount of energy conserved in the system computed according to value of output; 2. Amount of energy conserved directly for value of output; 3. Amount of energy conserved indirectly for value of output; 4. Amount of energy conserved from reduced consumption for products; 5. Contribution of increased value of products to δE^D_n; 6. Contribution of increased value of products to δE^J_n; 7. Amount of energy conserved from increased value of products; 8. Amount of energy conserved from the product mix

Thus, the formula to calculate energy conservation rates is:

$$\gamma_n = \delta E_n/(1 + \alpha_n)E_{n-1}$$

γ: Energy conservation rate in the year n

E_{n-1}: Amount of energy resources consumed in year n-1

α_n: Economic indicator in year n relative to the rate of increase in year n-1.

Based on the detailed decomposition of the structure of the amount of energy resources conserved, I propose that:

1. The formula used to compute amounts of energy conserved should be:

$\delta E_n = \delta E^{\sigma}{}_n$

2. The formula used to compute energy conservation rates should be:

$\gamma_n = \delta E^{\sigma}{}_n/(1 + \alpha_n)E_{n-1}$

(The meaning of all items in these formulas is the same as before).

Table 1. Table of Investments in Technological Energy Conservation

Period	Item	Investment (billion yuan)			Amount of energy conserved (million tons of standard coal)	Unit investment in energy conservation (yuan/ton of standard coal conserved)
		Total	Amount self-raised	Percentage self-raised		
	Capital construction for energy conservation	5.926	1.969	33.23	13.900	426.33
Sixth 5-Year Plan	Technical upgrading to conserve energy	5.301	2.002	37.77	21.204	250.00
	Subtotal	11.227	3.971	35.37	35.104	319.82
	Capital construction for energy conservation	11.309	5.513	48.75	20.952	539.76
Seventh 5-Year Plan	Technical upgrading to conserve energy	4.652	2.732	58.73	9.585	485.34
	Subtotal	15.961	8.245	51.66	30.537	522.67
Total over 10 years		27.188	12.216	44.93	65.641	414.19

Source of data: ZIYUAN HELI LIYONG SHOUCE [Handbook of Rational Resource Utilization], China Science and Technology Press, 1991.

The essence of the question of energy conservation is technical progress (including advanced technology and scientific management). Detached from technical progress, energy conservation will become a tree without roots and water without a source. Moreover, energy conservation requires the associated capital inputs. Without capital guarantees, technical progress is hard to achieve.

Comparing the Sixth 5-Year Plan and the Seventh 5-Year Plan, the amount of energy conserved by technological projects was a reduction of 4.57 million tons of standard coal, a reduction rate of 13.01 percent. The primary factor was insufficient capital inputs. The investment per ton of standard coal conserved during the Seventh 5-Year Plan was 63.43 percent higher than during the Sixth 5-Year Plan, but the total amount of investments increased by just 42.17 percent. Moreover, this was due mainly to an increase in self-raised capital, which increased at a rate of 107.63 percent. The portion of state loan allocations increased by just 2.12 percent. The total amount invested in technical upgrading to conserve energy was even lower than during the Sixth 5-Year Plan. The total amount invested by the state in technical upgrading to conserve energy fell from 3.299 billion yuan during the Sixth 5-Year Plan to 1.920 billion yuan during the Seventh 5-Year Plan, a reduction of 41.80 percent. In a situation of rising costs for energy conservation and shrinking investments in energy conservation, the 54.80 percent reduction in the amount of energy conserved due to technical upgrading to conserve energy from the Sixth 5-Year Plan to the Seventh 5-Year Plan was unavoidable.

Some people have called blind increases in energy resource supplies and relying on low efficiency high consumption modes of production to develop our economy "eating the food of our ancestors and doing evil to our descendants". While the statement is an extreme one, it is still true. A low efficiency of energy resource utilization wastes energy resources and increases environmental pollution. Thus, regarding the question of

conservation and development, we absolutely cannot simply consider the economic benefits of energy resources. We must also consider environmental protection, technical progress, and other questions. I pointed out in 1986 that the rate of growth in unit investments in energy conservation will be greater than the rate of growth in unit investments for energy resource development, but the reasons for making its unit investments exceed energy resource development and having to adhere to energy conservation work in the long term are that we must consider the requirements of environmental protection, transportation, technical progress, and other areas.

Environmental protection has now become an issue that has attracted the attention of all of mankind, whereas the development and utilization of energy resources is the main cause of environmental pollution. Thus, conservation of energy resources of course provides the most effective way to reduce environmental pollution. Given China's current situation of an underdeveloped economy, relatively low production levels, and great potential for energy conservation, we must make a theoretical clarification of the true meaning of conserving energy resources. For example, realistically assessing accomplishments in energy conservation will sweep away ideological chaos in future development of energy conservation work.

I propose that future calculations of the amounts of energy conserved only include two parts—technological energy conservation and administrative energy conservation. The amounts of indirect energy conservation at present in the future should be defined as only "the impact of structural readjustments on consumption of energy resources" and only serve as one factor that affects forecasts of demand for energy resources and not be treated as amounts of energy conserved.

I suggest that it be clarified that average annual energy conservation rates in China during the past 10 years were less than 2 percent and that the amounts of energy conserved dropped by 13.01 percent from the Sixth 5-Year Plan to the Seventh 5-Year Plan. These should attract the attention of society.

I propose increasing capital and technology inputs in energy conservation and the gradual formation of an energy conservation industry to accelerate the commercialization of energy conservation technologies and products.

Strengthening Reformation of Energy Conservation Technology Under the New Situation

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[Article by the Technical Upgrading Office of the Conservation Department in the State Council Economics and Trade Office: "Further Strengthen Work on Technical Upgrading To Conserve Energy in the New Situation"]

[Text] Economic construction and reform and opening up in China have now entered a new stage of rapid development. Under the encouragement and guidance of the spirit of Comrade Deng Xiaoping's important talks and the Plenary Session of the CPC Central Committee Politburo, all of China and all industries are now striving to seize the favorable opportunity to accelerate the pace of reform and opening up and fighting to raise our national economy better and faster up to a new stage. Recently, the State Council issued its "Regulations on Transforming Administrative Mechanisms in Industrial Enterprises Under the System of Ownership by the Whole People". Their main objective is to push enterprises toward the market and turn enterprises into commodity production managers who make their own administrative decisions, are responsible for their own profits and losses, and are capable of self- development and self-restraint. Focusing on the transformation of administrative mechanisms, the government will change its duties and, based on the principle of separating the duties of government and enterprises, will focus mainly on planning, coordination, supervision, and providing services to enterprises. Facing the major reform described above and the new development situation, technical upgrading to conserve energy also faces several new situations and problems that require us to do conscientious thinking and research to adapt to the development of the situation and do better technical upgrading to conserve energy.

I. Accelerating the Pace of Economic Construction and Reform and Opening Up Makes Technical Upgrading To Conserve Energy Even More Urgent and Important, And It has More Favorable Conditions

A. Rapid economic development increases the pressure on the contradiction between energy resource supply and demand. China is a country with relatively small per capita energy resources that has experienced a persistent relative shortage of energy resources for a long period. During the past 10-plus years, serious shortage situations have appeared in energy resource supplies on several occasions and they have become a major factor that restricts development of our national economy and society in the present era. During 1992, faster economic development has again led to a rapid increase in demand for energy resources. However, because energy resource supplies are restricted by energy resource production and transportation, the contradiction between supply and demand is tending to grow again. During the first half of 1992, the gross value of industrial output at the township level and above in China increased by about 17 percent over the same period in 1991. Because of the impact of transportation on coal production, total primary energy resource production during the first half of 1992 dropped by 0.7 percent compared to the same period in 1991. To ensure production, materials and supply departments used up 20 million tons of coal stocks

during the first half of 1992, while power restrictions due to insufficient supplies of electricity occurred in several regions. At the end of the Seventh 5-Year Plan, the relevant departments estimated that if our GNP grows at an annual rate of 6 percent over the next 10 years and energy resource output can grow at an annual rate of 3 percent, output of primary energy resources in 2000 would reach 1.4 billion tons of standard coal. This would mean an energy resource shortage of 400 million tons of standard coal that must be dealt with through energy conservation. At an accelerated pace of economic development in the future, estimating an 8 to 9 percent annual growth rate in GNP and a 4 percent average annual growth rate in energy resource production, primary energy resource production in 2000 would reach 1.5 billion tons of standard coal, and our energy resource shortage would reach 800 to 900 million tons of standard coal, which would mean even heavier energy conservation tasks. Moreover, because it will be difficult to change coal's dominance of China's energy resource structure in the short term, the pressures of environmental pollution that result will continue to grow. Thus, strengthening energy conservation, especially relying on technical upgrading and accelerating the pace of technical upgrading to conserve energy, are obviously even more urgent and important. Using upgrading to convert advanced energy conservation technology into forces of production as quickly as possible and greatly increasing energy resource utilization rates requires that governments at all levels make this decision and that enterprises maintain normal production and develop more quickly under limited energy resource supply conditions, so this must also be done. Otherwise, it may not even be possible to maintain normal production, much less improve economic results. The objective pressures from this type of contradiction between energy resource supply and demand are now forcing enterprises to pay attention to and reinforce technical upgrading to conserve energy.

B. Intensive reform and pressures from market competition have increased the inherent impetus in enterprises. As reform and opening up proceeds in an intensive manner, prices for energy resources, raw materials, and other elementary products gradually are rising. While reform of energy resource and raw materials prices in China has not been fully put into place, low prices for energy resources have already become a key factor affecting development of the energy resource industry. However, after accelerating the pace of economic development in a situation of increasing shortages of energy resources, energy resource supplies received by enterprises that are truly priced according to plans are shrinking (moreover, there have been continual readjustments in prices within plans), while the portion that relies on market regulation continues growing. In many regions now, especially those areas whose economies have developed more quickly and which have greater shortages of energy resources, enterprises must expend a great deal more effort and cost than in the past in pursuit of energy resource supplies, which inevitably increases real production costs in enterprises. According to 1991 statistics, total materials consumption in China's industrial enterprises (including equipment depreciation and major overhaul costs) now account for 87.2 percent of plant costs, including 60 percent for materials purchased from outside and 11.5 percent for fuel and motive power purchased from outside. During the past several years, additional increases in energy resource and raw materials prices have led some places to report that materials consumption as a proportion of costs has risen again. Energy consumption in Heilongjiang Province's machine building and electronics industry has risen from 13 percent in the past to 17 percent and in communication and transportation has risen from 37 percent to nearly 45 percent. Energy resource and raw materials consumption levels in enterprises are having a growing impact on their economic results and their status in market competition. To be able to gain a foothold in increasingly fierce competition in the domestic and international markets, besides having to adapt to market demand, continually develop new products, and improve product quality, enterprises must also make an effort to focus on energy conservation and reducing consumption in an effort to bring production costs down. Otherwise, even with good products they may lose their advantage in market competition because their materials consumption and production costs are too high. Many enterprises at present now feel enormous pressures from this fierce competition. Many advanced enterprises have used stronger technical upgrading to conserve energy, adopted new technologies, and achieved output increases while reducing energy consumption, which has greatly improved their economic results. There are also many enterprises that have used technical upgrading, reinforced energy conservation equipment, and product development and production to fight for markets. Continued reform in energy resource prices and market competition have brought pressures and motive power to enterprises and will inevitably spur enterprises to strengthen technical upgrading to conserve energy.

C. Reform and opening up and accelerated development of our economy have increased the strength of the state and enterprises and may gradually increase investments in technical upgrading to conserve energy. In 1992, when the state was making arrangements for special demonstration projects on technical upgrading to conserve energy, it also increased blower and water pump replacement and upgrading projects in coal mines. There have also been increases in the capital raised in all provinces, autonomous regions, and municipalities as well as enterprises for technical upgrading to conserve energy. In addition, reform and opening up have led to the continual appearance of various types of new energy conservation technology and speeded up the transmission and circulation of technical upgrading to conserve energy information. The implementation of regulations on transforming administrative mechanisms has also given enterprises greater authority to make their own administrative managerial decisions in managing production

based on market demand. Several places have now made stipulations on a downward transfer of authority over inspection and approval of investments in technical upgrading projects, which has reduced much unnecessary administrative intervention and made it more convenient for enterprises to carry out technical upgrading to conserve energy.

The three factors outlined above affect and promote each other and overall, they have helped spur enterprises to pay greater attention to and strengthen technical upgrading to conserve energy. We should seize this favorable opportunity, provide active guidance, and try to raise technical upgrading to conserve energy up to a new level.

II. Problems That Cannot Be Ignored Still Exist Now in Technical Upgrading To Conserve Energy

A. Reliance on S&T progress and reinforcement of technical upgrading to conserve energy are still far from receiving as much attention as they should. For the past several years, the state has repeatedly stressed the energy resource construction principle of "combining development and conservation", and it has proposed that technical upgrading must definitely give primacy to energy conservation and reducing consumption. In actual work, however, regardless of the level, few have truly been implemented and attained requirements in actual work. The number and proportion of investments in technical upgrading to conserve energy arranged by the state have still not attained levels reached in the Sixth 5-Year Plan. In 1991, investments in energy conservation replacement and upgrading in enterprises under the system of ownership by the whole people in China accounted for just 3.4 percent of total investments in replacement and upgrading and the amount of their investments was also less than 3.6 percent of investments in energy resource development. Many departments have not paid attention to energy conservation and reducing consumption when arranging technical upgrading plans and some have even used capital received in the name of energy conservation to arrange projects to expand their processing capacity. The "Provisional Regulations for Management of Energy Conservation" promulgated by the State Council call for key enterprises in regions that ship in energy resources to set aside no less than 20 percent of their depreciation funds for use in energy conservation, but in reality many enterprises have not done this. During the present process of accelerating economic development, some enterprises have also been concerned only with pursuing expanded scales, increasing value of output, and seeking speed, and have not paid attention to focusing on energy conservation, reducing consumption, or improving economic results. During the past 2 years, because of a more stable energy resource supply situation, relatively low overall present energy resource prices, the fact that energy resource consumption still does not account for a too high proportion of production costs in several enterprises, and other effects, this has caused several enterprises to feel that high energy consumption does not have a serious impact on enterprise economic results, so they have relaxed energy conservation work and are unwilling to invest in technical upgrading to conserve energy.

B. An acute contradiction is insufficient capital for technical upgrading to conserve energy. Technical upgrading to conserve energy involves a great deal of work covering a broad area and the tasks are extremely numerous, but it has been impossible to carry out many urgently needed upgrading projects because of capital shortages. In the past few years, as economic development has quickened there has been a sharp increase in demand for capital in all areas which has made the capital shortage even greater. Now, while the proportion of investments in technical upgrading to conserve energy arranged by the state is too low and because economic results in most enterprises are not high, they have a limited capability for relying on their own forces to invest in technical upgrading to conserve energy. Moreover, because energy resource prices are too low, the direct economic benefits from investments in several technical upgrading projects to conserve energy are not high when calculated according to the price of the energy resources that are conserved. This has led to it taking a relatively long time to recover loans and affected the enthusiasm of banks for making loans. It has also increased the difficulties involved in raising capital for energy conservation in enterprises. These things have made the contradiction of insufficient capital for technical upgrading to conserve energy even more acute.

C. There are still not enough technical reserves needed to accelerate technical upgrading to conserve energy. Using blowers and water pumps as examples, although the state allocated special funds and decided to accelerate upgrading of coal mine blowers and water pumps in 1992, they have encountered major problems in implementation in selecting high efficiency energy-saving main fan blowers suitable for coal mines, and there is also very little margin in selecting high efficiency wear-resistant main drainage water pumps to provide to coal mines, so technical reserves obviously are inadequate. This situation is not an isolated example and there are many other realms. There is great potential for energy conservation, but upgrading cannot be done because of a lack of the needed technical equipment or the technology has not passed tests. While achievements have been inspected and confirmed for some technologies, there is often no way to use them for technical upgrading because of a lack of experience in industrial applications. As our economy grows more quickly, the tasks involved in technical upgrading to conserve energy will become heavier and the technology requirements will become higher. This requires the development of more new energy conservation technologies to serve as reserve strengths for technical upgrading. At present, the few expenditures on developing technical upgrading to conserve energy have not aroused sufficient concern and there is not enough integration of technology development with technical upgrading, which has formed "two separate systems". In summary, there is not enough

development of new energy-saving technology, which is affecting technical upgrading to conserve energy and causing shortages of reserve strengths for future technical upgrading to conserve energy, and this must receive sufficient attention.

III. How To Further Reinforce Work on Technical Upgrading To Conserve Energy

A. Adapt to the situation, seize the opportunity, truly transform concepts, actively reinforce work on technical upgrading to conserve energy. In the present tide of accelerated reform and faster economic development, work on technical upgrading to conserve energy also faces new opportunities and challenges. The situation will eventually compel enterprises to make the correct decision to pay more attention to and strengthen it. We must adapt to the situation, correctly guide enterprises in fully understanding and strengthening technical upgrading to conserve energy, and increase energy resource utilization rates. This will directly assist enterprises in reducing production costs, improving results, and strengthening their position in market competition, and it will raise overall enterprise personnel quality and equipment levels, which has major significance for greater development of reserve strengths. Enterprises should closely integrate and unify a focus on product development and product quality with a focus on energy conservation and technical upgrading to conserve energy so that enterprises seize opportunities quickly, change from passively "wanting me to change" to actively "wanting to change", and actively create the conditions for reinforcing work on technical upgrading to conserve energy.

B. Prepare good plans, seize key points, truly produce real results in improving benefits and energy resource utilization rates. Technical upgrading to conserve energy involves a great deal of work covering broad areas and is a long-term task. All departments and all regions and enterprises must start from reality and prepare programs based on industrial policies. During one period and stage, they must concentrate their finances in a sharp focus on a few key points, clarify objectives and requirements, and conscientiously carry them out. At present, special attention should be paid to focusing on several energy conservation projects with substantial energy-saving potential, economical investments, quick results, and significant benefits and which have a major impact on industrial and enterprise technology development in an effort to produce real results and fight for the trust of the people and the trust of banks. Shanghai Municipality, for example, proposed focusing on the "three 100s" during 1992, referring to 100 key enterprises, unit consumption for 100 types of products, and 100 technical upgrading projects to conserve energy, to increase energy resource utilization rates, catch up with and surpass advanced historical international and domestic levels, and reinforce enterprise reserve strengths. This is a very good method.

C. Open up ideas, create conditions, raise capital through multiple channels, spur technical upgrading to conserve energy. In the future, the state and local governments at all levels should gradually increase investments in technical upgrading to conserve energy. When enterprises are arranging technical upgrading projects to conserve energy, however, submitting applications for capital to higher authorities is one aspect. Because the state has extremely limited special loan funds for energy conservation that will also have to be used primarily on technologically advanced energy conservation demonstration projects in the future, there are often many projects with economical investments and good economic benefits that the state will not be able to arrange with certainty, so enterprises must expand their capital channels. 1) When applying for and arranging all types of technical upgrading projects, they should include technical upgrading measures for conservation and reduced consumption. 2) They should make full use of their own capital, including depreciation funds, major repair funds, production and development funds, and so on. 3) Enterprise investments under 50,000 yuan for R&D on single pieces of equipment and single new energy-saving technologies can be included in production costs. 4) Fight for all types of local bank credit capital. 5) Fight for capital in the shift from allocations to loans in local financial administrations. 6) Administrative departments of higher authorities have already arranged funds for technical upgrading to conserve energy. 7) Regions with the proper conditions can raise capital locally and issue bonds. 8) Use capital from chartered loan companies. 9) Use foreign exchange loans from the World Bank and Asian Development Bank for assisting China. 10) Use all types of channels for cooperation and joint investments with foreign countries or use foreign investments to develop new energy-saving technologies, techniques, materials, equipment, and so on for technical upgrading to conserve energy. In summary, enterprises must change from the single channel of applying for capital from higher authorities to raising capital through multiple channels and from multiple sources and strive to achieve technical upgrading to conserve energy.

D. Strengthen integration between production, education, and research and integration between technical upgrading, technology development, and technology imports to promote technical upgrading to conserve energy to a new stage. As we enter the 1990's, the development of science and technology changes with every day. Technical upgrading to conserve energy must keep pace with the era, fully apply new S&T achievements from China and foreign countries, achieve advanced levels of modern technology development, and use technical upgrading to convert S&T achievements as quickly as possible into real forces of production. For this reason, we must encourage and strengthen close cooperation between enterprises, institutions of higher education, and scientific research academies and institutes, organize or integrate their particular advantages, fully mobilize and utilize initiative in all areas, and join together to open up new realms, technologies, products, and equipment

while at the same time integrating technical upgrading to conserve energy with technology development and technology imports, continually raising levels and grades of technical upgrading to conserve energy, and promoting the gradual movement of technical upgrading to conserve energy up to a new stage. This would aid in present work on technical upgrading to conserve energy and create favorable conditions for strengthening technical reserves for technical upgrading to conserve energy.

E. Government departments should change their functions and serve technical upgrading to conserve energy.

1. Simplify application and approval procedures for technical upgrading projects to conserve energy, actively study giving enterprises full decision making rights regarding technical upgrading to conserve energy. Enterprise technical upgrading to conserve energy is a key investment direction for state encouragement and support, and the project application and approval procedures should be simpler than regular technical upgrading projects. Consideration can be given to enterprises in the future using their own capital to carry out technical upgrading to conserve energy and allow them to not submit reports for approval and instead only prepare records for their projects for cooperative relationships with energy resources, communication, raw materials, and so on that do not require a comprehensive balance by the state, regardless of the size of the project. Under similar conditions, for the capital that enterprises raise themselves, besides their own capital, they can also use bonds, stocks, and other arrangements to raise capital. If these capital sources are reliable, they only have to submit project proposals for approval. Projects under the jurisdiction of governments at all levels that require a comprehensive balance in the cooperative relationships among capital, energy resources, and raw materials should be divided into levels, with those at a particular level applying and receiving approval at that level. However, application and approval procedures should also be simplified according to the project situation and amount of the investment. For example, usually only a project proposal should have to be submitted and approved for replacement and upgrading projects for electromechanical equipment that the state has formally announced will be discarded.

2. Reinforce information services for technical upgrading to conserve energy. We must make an effort to collect, study, and analyze information on development and research achievements and technical upgrading from China and foreign countries regarding new energy-saving technologies, techniques, materials, and equipment, gain an understanding of investments by regions and industries in technical upgrading to conserve energy and information on progress in key demonstration projects, immediately organize its transmission and circulation, and use information to guide work for technical upgrading to conserve energy in enterprises.

3. Study and formulate economic policies to spur technical upgrading to conserve energy, use financial, credit, taxation, and other economic measures to make full use of economic levers to encourage enterprises to strengthen technical upgrading to conserve energy. At present, we must focus on ways to help enterprises open up capital sources for technical upgrading, summarize trial points, implement policies for using the benefits from energy conservation to repay loans, and so on.

4. Focus more on important demonstration projects for technical upgrading to conserve energy. This is another important measure for government departments to strengthen guidance and provide service to work in enterprises for technical upgrading to conserve energy. To better organize and make full use of its role, project selection in the future should place more stress on demonstration properties and the advanced qualities of technology. Competitive mechanisms can be imported as appropriate for selecting units to assume responsibility for projects. Policies should encourage and support the integration of production, education, and research and closely integrate technical upgrading with technology development and technology imports, and use the convening of on-site meetings and other arrangements to strengthen propaganda and extension for demonstration achievements.

Accelerating Economic Development, Improving Energy Conservation

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[Article by Yue Luqun [1471 7773 5028], Song Sen [1345 2773], and Wang Aijuan [3076 1947 1227] of the Ministry of Energy Resources Energy Conservation Department: "Accelerating Economic Development, Promoting Energy Resource Conservation—A Review of Energy Conservation Work Over the Past Decade and Prospects"]

[Text] Since publication of Comrade Deng Xiaoping's speeches during his tour of southern China in early 1992, all areas have earnestly studied and adhered to the spirit of the speeches, the pace of reform and opening up has been accelerated, and a situation of rapid growth in our national economy has appeared.

In the future, the annual rate of growth of our national economy will exceed the original 6 percent, but one problem that will be encountered in maintaining this rather high rate is the energy resource problem. By the year 2000, demand for energy resources will surpass the originally planned 1.4 billion tons of standard coal. However, in terms of China's coal and petroleum resource and regional distribution conditions, we may encounter quite a few difficulties in further increasing energy resource output. Without a balance of energy resources, we may be able to purchase them on the international market and of course coastal regions can import several energy resources from the international market if they have the foreign exchange. However, it

must also be noted that China is a big energy consuming nation, so relying on the international market for our energy resource supplies is unimaginable. Thus, the only way out is to combine increased energy resource output with major efforts to develop conservation of energy resources and place energy conservation in a prom nent status. Moreover, China's energy resource utilization rates are relatively low, so we should focus on development as well as conservation, and we must take the route of intensification, develop tertiary industry, readjust the industrial structure, carrying out upgrading in industries that are big consumers of energy, and develop energy-saving electromechanical products so that our limited energy resources can play an even greater role.

I. A Review of Energy Conservation Work Since the 1980's

For the past 10-plus years, all regions and all departments have conscientiously adhered to the principle of "combining energy resource development and conservation, giving primacy to conservation in the near term". Readjusting the industrial structure, strengthening management, formulating various energy conservation laws and regulations, and making major achievements starting with a focus on hectic and blind action and on drips and leaks and moving on toward upgrading high energy consuming equipment have played important roles in resolving China's energy resource shortage problems and spurring development of China's national economy. These are mainly manifested in:

1. Significant achievements in macro energy conservation. Energy consumption per 10,000 yuan of GNP was 13.36 tons of standard coal in 1980 and 9.3 tons of standard coal in 1990, a reduction of 30 percent and a yearly energy conservation rate of 3.5 percent, including an average of 4.7 percent during the Sixth 5-Year Plan and 2.3 percent during the Seventh 5-Year Plan. Calculated according to chains, there was total energy resource conservation and reduced utilization of 270 million tons of standard coal. This played an important role in spurring and ensuring sustained development of our national economy in the 1980's.

2. Significant intensification of energy resource conservation elasticity coefficients. The energy resource elasticity coefficient from 1980 to 1990 was 0.56, including 0.49 during the Sixth 5-Year Plan and 0.65 during the Seventh 5-Year Plan. This shows that one-half of the growth in our national economy over the previous 10 years was achieved through reliance on energy conservation. There were also new advances in energy conservation in 1991. Compared to 1990, there was energy resource conservation and reduced utilization of 32 million tons of standard coal, an energy conservation rate of 3 percent. Average electricity consumption per 10,000 yuan in gross value of industrial output in industrial departments dropped from 2,476 kWh in 1990 to 2,395 kWh in 1991, conserving 15.8 billion kWh of electricity, a power conservation rate of 3.3 percent. These achievements were made mainly through continual intensification of reform, a relatively quick resurgence of our national economy, and changes in the structure of our economy. China's GNP grew by 7 percent from 1990 to 1991. The gross value of industrial output grew by 12.9 percent over 1990. In particular, the processing industry, which consumes fewer energy resources, grew by 15.4 percent, and its proportion of the gross value of industrial output grew from 73.38 percent in 1990 to 74.54 percent in 1991, an increase of 1.16 percentage points. On the other hand, the excavation and raw materials industries, which consume more energy resources, grew by just 8.6 percent and their proportion of the gross value of industrial output dropped from 26.62 percent in 1990 to 25.46 percent in 1991.

3. Reductions in unit energy consumption for primary energy-consuming products. During the 10-year period, the state focused on checking over 60 types of industrial products. Unit consumption declined for about two-thirds of them. For example, electricity consumption per ton of electrolytic aluminum dropped from 20,342 kWh in 1980 to 16,750 kWh in 1990. Coal consumption to supply electricity at thermal power plants dropped from 448 grams [per kWh] of standard coal in 1980 to 427 grams of standard coal in 1990. Total energy consumption per ton of steel dropped from 2.04 tons of standard coal to 1.625 tons of standard coal. Consumption of standard coal per ton of ammonia in large chemical fertilizer plants dropped from 1.43 tons to 1.36 tons. Consumption of standard coal to process a ton of crude oil dropped from 129 kg to 105 kg. New achievements were also made in reducing unit energy consumption for products during 1991. Coal consumption to supply electricity at thermal power plants was 424 grams, a reduction of 3 grams from 1990, which conserved 1.5 million tons of standard coal. With the exception of some increases, total energy consumption per unit for 13 types of products in the chemical industry dropped to varying degrees, conserving 1.47 million tons of standard coal. Total energy consumption per unit for 10 types of non-ferrous metal products was 8.7 tons of standard coal, a reduction of 0.3 tons of standard from 1990, which conserved about 480,000 tons of standard coal. Total energy consumption per ton of steel in the metallurgical industry as a whole was 1.608 tons of standard coal, down slightly from 1990, which conserved about 200,000 tons of standard coal. Total energy consumption per unit work amount for railroad locomotives was 78.6 kg of standard coal, a reduction of 5.5 kg of standard coal from 1990, which conserved about 1.1 million tons of standard coal.

These achievements were made through all regions and all departments resolutely focusing during the past several years on energy conservation management, formulating objectives, implementing responsibility, tracking and checking, and implementing various forms of energy conservation contractual responsibility systems; raising capital through multiple channels, increasing investments in energy conservation, relying on technical

progress, and working hard at technical upgrading; and simultaneously continuing to formulate and perfect energy conservation laws and regulations, doing good energy conservation training, reinforcing propaganda on energy conservation, and turning energy conservation into the result of the mass activities of all of society.

II. Lags in Energy Conservation and Their Causes

During the past 10-plus years, while China has made substantial achievements in energy conservation and consumption reduction work that have contributed to the development of our national economy, we still lag substantially behind the advanced industrial nations. This is manifested primarily in low energy resource utilization rates, poor economic results, and high unit energy consumption for our primary energy consuming products. Statistics indicate that China's energy resource utilization rate is about 30 percent, whereas the developed countries have reached 50 percent. In seeking the causes for this, in addition to enterprises focusing on production while neglecting results, failing to place energy conservation in it proper status, energy resource prices that are too low, inadequate capital investments in energy conservation, and other factors, there are several other primary causes:

A. Impact of the energy resource structure Coal dominates China's primary energy resources. Coal accounts for 76.2 percent of our total energy resource consumption while petroleum, natural gas, hydropower, and other superior quality energy resources account for just 23 percent. In most of the developed nations at present, petroleum and natural gas usually account for over 60 percent of their energy resource structure. Moreover, the efficiency of energy-consuming equipment in an energy resource structure dominated by coal is far lower than in a structure dominated by oil and gas and the economic benefits from energy resources are also much poorer. In addition, it can also cause environmental pollution. In terms of China's current proven fossil fuel reserves and development plans, it will be hard to change our energy resource structure that is dominated by coal within the next 10 years.

Coal in China is utilized mainly through direct combustion, with just 32.8 percent being converted to secondary energy resources (electricity and coke), which is far lower than the 80 to 90 percent of coal that is converted into secondary energy resources in the developed countries. The greater the proportion of coal that is converted into secondary energy resources, the higher the utilization rate for energy resources. The proportion now being converted in China is relatively low, which has seriously affected improvements in energy resource utilization rates.

B. Impact of the industrial structure and production scales Consumption of energy resources at present in China's metallurgical, chemical, and construction materials industries accounts for about 31 percent of total energy resource consumption in China. These three industries consume large amounts of energy and have a low efficiency of energy resource utilization. With the exception of a few large enterprises in these industries that have advanced equipment and technology, the scale of production in most enterprises is too small, equipment and technologies are both backward, and product energy consumption is rather high. For example, the average capacity of China's blast furnaces is 96 cubic meters. In contrast, it is 2,500 cubic meters in the developed countries. Only 22 percent of China's steel is continuously rolled whereas the world average level is 49 percent, so our total energy consumption per ton of steel is about 60 percent higher than in the developed countries. In China's chemical fertilizer industry, large chemical fertilizer plants only account for 22 percent of output, medium-sized plants account for 23 percent, but small plants account for 55 percent. Consumption of energy resources in small plants is 1.1 times the amount in medium-sized plants and 1.8 times the amount in large plants. In our construction industry, China's medium-sized and small enterprises produce 80 percent of our total output of cement. In terms of technology, cement produced by the dry method accounts for only 34 percent of our total cement output whereas this figure in the developed countries is now over 90 percent. Thus, energy consumption for cement in China is far higher than world levels.

C. Impact of surplus heat utilization China has done some work over the past 10 years in the area of industrial surplus heat utilization and made substantial achievements, having formed the capability of conserving over 5 million tons of energy resources a year. Compared to the developed nations, however, we still lag substantially behind in surplus heat resource management, recovery technology, and recovery facility levels and utilization. A survey of China's industrial surplus heat resources shows that four industries—metallurgy, construction materials, light industry, and machinery—have surplus heat resources of about 19.49 million tons, of which 12.1 million tons is recoverable. We are now recovering 3.32 million tons, just 27.4 percent of the recoverable amount.

III. Energy Conservation Goals and Measures for the 1990's

Based on the "10-Year Program and Eighth 5-Year Plan Outline Concerning Development of Our National Economy and Society" that was passed at the 4th Plenum of the Seventh People's Congress, total output of primary energy resources in China will reach 1.172 billion tons of standard coal in 1995, which is an average annual growth rate of 2.4 percent. Within 5 years, we must reduce energy consumption per 10,000 yuan in GNP from 9.3 tons in 1990 to 8.5 tons in 1995, which is an average annual energy conservation rate of 2.2 percent and would conserve a total of about 100 million tons of standard coal over 5 years. To achieve China's second strategic objective in the year 2000 in a situation of accelerated development of our national economy and greater shortages of energy resource supplies, the energy

conservation tasks are even more numerous. To complete these tasks, we must do the following work well:

A. Strengthen macro regulation and control Based on the "Provisional Regulations for Energy Conservation Management" promulgated by the State Council, try to formulate an "Energy Conservation Law" as quickly as possible to make energy conservation work form a set of complete management systems and legislative systems.

1. Use taxation and credit to support and encourage all industries to adopt energy-saving techniques, technology, and equipment, formulate different tax rates for energy-saving products and energy-consuming products, provide preferential low-interest loans for energy conservation projects.

2. Readjust energy resource prices when appropriate, increase them as a proportion of product costs, make enterprises pay more attention to conserving energy resources.

3. Readjust the product mix and industrial structure, restrict development and production of industries and products with high energy consumption and low efficiency such as small-scale iron and steel, small-scale cement, small-scale oil refining, small-scale chemical fertilizer, small-scale thermal power, and so on.

B. Implement scientific management of energy conservation Perfect energy conservation management systems (including organizational structures) in all regions and all departments, use the overall program for our national economy as a guide in compiling energy conservation programs for departments, industries, and regions, formulate the relevant economic policies and technology policies and standards for energy conservation.

1. Do good management of energy consumption quotas. Reasonable energy resource consumption quotas should be formulated for enterprises and products and they should be supervised and checked.

2. Continually explore, summarize, and develop advanced experiences and theories in enterprise energy conservation management. Do more extension of those that are mature and have universal properties.

3. Do good training, improve the energy resource management levels of technical personnel, administrative personnel, and operating personnel.

4. Strengthen propaganda, increase the consciousness of energy conservation in all of society. Use all types of propaganda tools to carry out sustained and broad ranging propaganda on energy conservation in a planned way, allow all of society to recognize the importance of conserving energy resources, establish "resource consciousness", "environmental consciousness", and "energy conservation consciousness", cherish energy resources.

C. Increase capital inputs, reinforce energy conservation reserve strengths All departments and all regions should open up channels and gradually increase capital inputs in energy conservation, but they cannot rely on the state. For capital channels, one is to use retained local energy resource and communication funds for sustained rolling utilization and a second is income from higher prices for excess consumption of energy resources. A third is for enterprises to raise capital themselves. They can also fight for bank loans. In summary, investments should develop toward diversification, use multiple channels to raise capital, increase energy conservation strengths, and reinforce energy conservation reserve strengths.

D. Strive to adopt advanced energy conservation technology To increase the efficiency of energy resource utilization, we must rely on S&T progress and actively adopt new technologies, new techniques, and new equipment to replace and upgrade high energy consuming backward production technology, techniques, and equipment. For the next several years we must develop energy-saving technology in these areas:

1. Improve coal combustion technology and heat energy utilization rates. Coal dominates China's primary energy resources. We now have about 400,000 industrial boilers and industrial kilns and ovens whose annual coal consumption accounts for about two-thirds of our total coal output. Their efficiency is very low and we must focus on additional upgrading. We must actively develop centralized heat supplies and heat and power cogeneration and do R&D on new combustion technologies, high efficiency combustion facilities, and computer monitoring and control to increase the thermal efficiency of boilers, kilns and ovens, and heat supply systems.

2. Given coal's dominance of China's energy resource structure, increase the proportion of it that is converted, for example, increase the proportion of coal used to generate electricity from 26 percent in 1990 to 34 percent in 2000. We must also increase the proportion of coal that is dressed and the depth of processing.

3. Develop mature new energy-saving technology in all industries, such as expanding dry method production in the metallurgical, chemical, and construction materials industries, vertical tube preheaters, decomposition outside of kilns, hollow-core bricks, light hydrocarbon recovery, and so on. In particular, we must improve production technologies for eight types of high energy consuming products including electric furnace steel, iron alloys, electrolytic aluminum, calcium carbide, synthetic ammonia, sodium hydroxide, cement, and so on.

4. Accelerate upgrading of the electric power industry's existing 26,000MW of moderate and low-pressure generators. With the exception of some power grids, generators and those with stable heat loads should be converted to heat supply generators and the remainder should be replaced with new high parameter, high capacity, low coal consumption generators.

5. Develop high-efficiency energy-saving electromechanical products. The focus is on increasing the efficiency of energy resource utilization in blowers, water pumps,

compressors, electric motors, transformers, automobiles, diesel engines, and other common electromechanical equipment used in large amounts over broad areas. At the same time, we should adopt advanced technology to upgrade existing equipment, for example using variable frequency speed governing technology to increasing the operating efficiency of blowers and water pumps, and so on.

6. Conserve electricity used for lighting, make major efforts to extend new energy-saving light sources to replace the incandescent bulbs now in wide use. Examples include rare-earth three primary color fluorescent lamps, high- pressure sodium lamps, metallic chimney chemical compound lamps, and so on which have a luminescent efficiency over 3 times greater than incandescent lamps and significant electricity conservation benefits.

7. Use low energy consumption, high efficiency transportation equipment to replace backward transportation equipment. Based on China's energy resource structure and our supply and demand situation for electric power and oil products, continue replacing steam locomotives with electric locomotives and internal combustion locomotives, use large and medium-sized diesel vehicles to replace gasoline vehicles.

8. Do good insulation in structures, develop hollow-core bricks, improve wall structures and heating ventilation, control heating and cooling temperatures, make a major effort to reduce energy use in structures.

9. Household energy use for people in townships and towns should mainly develop shaped coal. In some large and medium-sized cities with the proper conditions, develop civilian coal gas. Cities in northern China should try to adopt centralized heat supplies for heating. For household energy use of rural people, we should make a major effort to extend wood-saving and coal-saving stoves and actively stabilize and develop biogas and small-scale hydropower. Strive to develop wind power, solar power, and other renewable energy resources.

The 1990's are the key decade for China's economic development. Completing our energy conservation tasks is of extremely great importance not only for spurring economic development but also for reducing environmental pollution in China. Through the common efforts of all the people of China, this goal certainly can be achieved.

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